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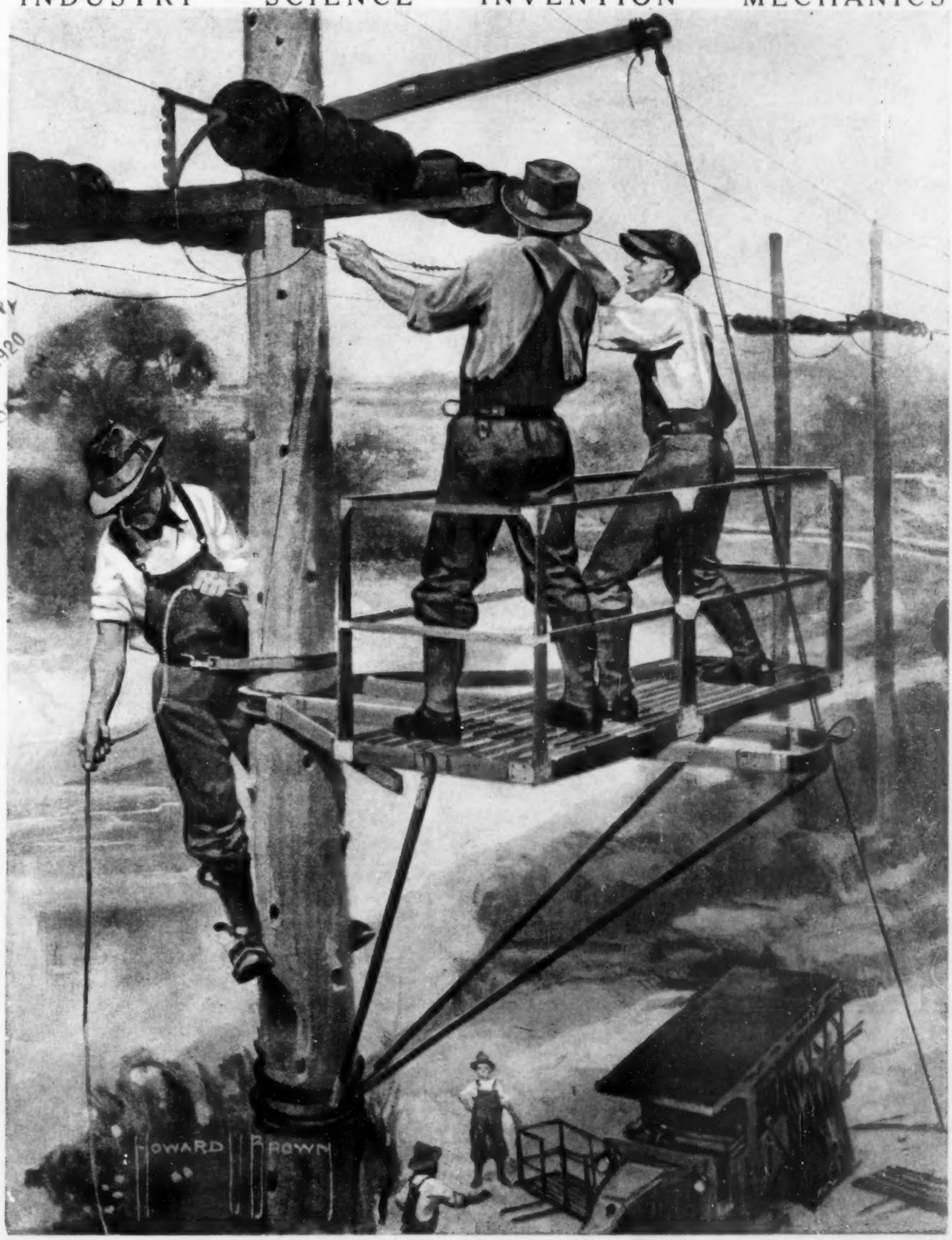
BUILDING IN THE WILDERNESS
SMOTHERING FIRE WITH BUBBLES OF GAS

SCIENTIFIC AMERICAN

A Weekly Review of Progress in

INDUSTRY · SCIENCE · INVENTION · MECHANICS



WORKING WITH BARE HANDS ON LIVE LINES BY MEANS OF THE SAFETY STAGE—[See page 219]

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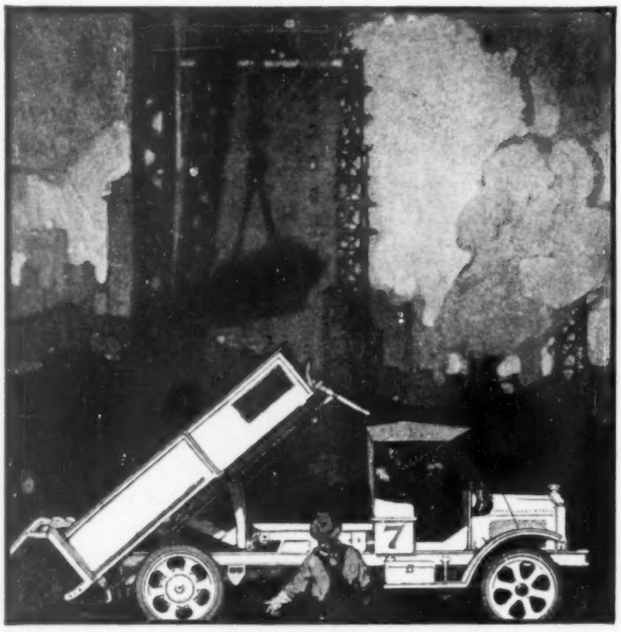

FIRST *in* Construction Hauling

IN the whole field of truck operation there is no more drastic demand upon power, efficiency and endurance than in hauling crushed stone, sand, brick, cement, lumber, structural steel and machinery.

Tons of material are literally dumped into the trucks from buckets, chutes or derricks. These loads are carried over torn-up ground, into and out of excavations, to places where the trucks must break their own path. Materials must be kept moving. Deliveries are vital. Trucks work day and night.

For years White Trucks have had a predominant position in this field. They are the mainstay of contractors, of road and bridge builders, of dealers in lumber and building supplies.

They not only stand up and keep going day in and day out, year after year; they pay dividends long after the investment is written off the books. White Trucks are distinctly a balance sheet proposition; their earning power is *sustained.*

White Trucks are used by contractors in 156 cities. They are used by 431 lumber dealers; by 218 dealers in building supplies and by 224 miscellaneous concerns in the building and contracting field; 365 states, counties and municipalities use White Trucks on road construction and maintenance work.

These owners know from their cost records that White Trucks not only do the *most* work, but they do it for the *least* money.

THE WHITE COMPANY, *Cleveland*

WHITE TRUCKS

A fire department you never heard of

HERE it is—posing for its picture. No clanging bells or shrieking sirens. No red lined coats. Nothing spectacular.

Just a few skilled workmen—yet these men save the ladder and the engine crews many a trip by making roofs fire-safe with Asbestos. For the time to put out fires is before they start. And there is no better way to prevent roof communicated fires than by covering roofs with Asbestos.

Moreover, it is not only through fire protection that Asbestos makes roofs safe, but also through weatherproof durability. In fact, Asbestos seems ordained by nature to be a roofing material. This wonderful fibrous mineral is not only absolutely fire-proof, but in roofing form it is immune to the disintegrating effects of sun, snow, hail, ice, rain, smoke and acid fumes.

On the big flat roofs of industrial plants and other buildings you will find Johns-Manville roofers applying permanent fire prevention with Johns-Manville Asbestos Roofing.*

And on thousands of smaller buildings the owners themselves, or their employees, are doing the same. For the many different types of Johns-Manville Asbestos Roofing give everyone the opportunity to protect what is ordinarily the most defenseless part of his building—the roof—with one of these roofings.

Asbestos Roll Roofing, Johns-Manville Standard and Colorblende Asbestos Shingles, Johns-Manville Asbestos Ready Roofing, Johns-Manville Corrugated Asbestos Roofing, Johns-Manville Built-Up Asbestos Roofings.

Johns-Manville Asbestos Roofings are approved by the Underwriters' Laboratories, Inc.

All Johns-Manville Asbestos Roofing is backed by Johns-Manville Service and Responsibility. Through our Roofing Registration Service we are able to keep in touch with Johns-Manville Roofing in Service. This is your assurance that it will give the service claimed for it.

H. W. JOHNS-MANVILLE CO., New York City
10 Factories—Branches in 64 Large Cities
For Canada: Canadian Johns-Manville Co., Ltd., Toronto

** In sixty-three cities throughout the United States and Canada there are Johns-Manville Branches, which have crews of expert roofers constantly employed in laying Johns-Manville Asbestos Roofing on large roof areas.*
And for the thousand and one types of modern buildings—including dwellings—Johns-Manville Asbestos Ready Roofings and Shingles are handled by dealers and dealer-contractors everywhere.

JOHNS-MANVILLE SERVICE COVERS THE CONTINENT

Through—

Asbestos
and its allied products

INSULATION
that keeps the heat where it belongs
CEMENTS
that make boiler walls leak-proof
ROOFINGS
that cut down fire risks
PACKINGS
that save power waste
LININGS
that make brakes safe
FIRE PREVENTION PRODUCTS

JOHNS-MANVILLE
Serves in Conservation

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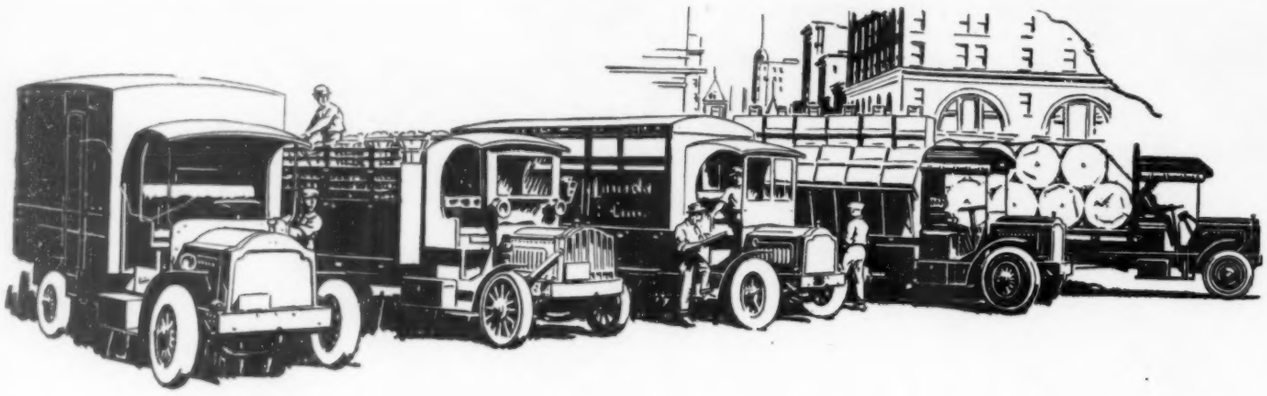


What makes engineering authority

VISIT the busy freight receiving platform of any railroad. Of the score or more motor trucks loading, there will be half a dozen assorted sizes doing practically the same work.

Why so many sizes for the same job? Which size is *right*? Who said so?

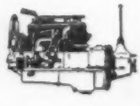
* * *

The business man can select his motor trucks either of two ways. He can trust to rule of thumb "commercial practice." Taking it for granted that the truck is right—that its parts are what they ought to be—and that his "saving" in first cost is a genuine economy.

Or he can go straight to the truck vouched for by *engineering authority*. Designed for the work it has to do. Each part designed in relation to every other part—and built under rigid supervision. *Sure saving in cost of transportation.*

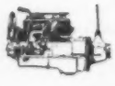
In all industrial America there is no higher example of engineering carried intensively into a product than the Packard Truck.

The 44 definite factors of superiority in the Packard Truck are the direct outcome of Packard intensive engineering.



Each size of Packard Truck designed for a specific transportation need.

Each size designed as a unit around its *engine* as a basis.



Rear-end, clutch, gears—each size the proper design for its own engine.

Packard unity of design overcoming that common difficulty—an engine too big for the rear-end, or driving mechanism too heavy for the engine.

One reason why Packard Trucks handle greater loads economically per hundred pounds of truck.

The design of the Truck—and of its parts. The selection of material. The new and advanced processes developed. Special machine equipment invented.

Packard standards in the finished truck ensured by holding one inspector responsible for the work of each twenty men throughout the Packard plant.

All leading up to the unequalled strength of the Packard truck parts and the high performance of the Packard Truck.

Packard engineering puts *economy on the road* ahead of cheapening production in the factory.

Low transportation costs shown by Packard Trucks—dependable performance—long life—all matters of record.

Records and the "44 factors" available to business men at local Packard headquarters.

"Ask the Man Who Owns One"

PACKARD MOTOR CAR COMPANY, *Detroit*

SEVENTY-SIXTH YEAR

SCIENTIFIC AMERICAN

THE WEEKLY JOURNAL OF PRACTICAL INFORMATION

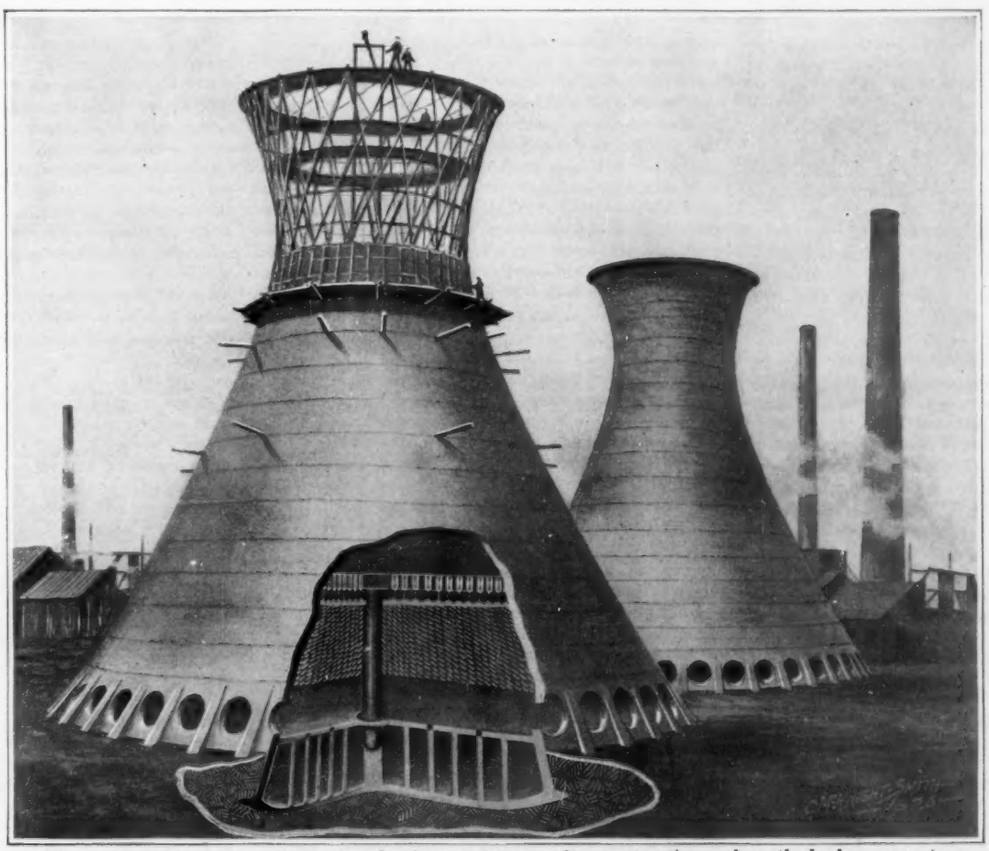
VOLUME CXXIII. NUMBER 10 | NEW YORK, SEPTEMBER 4, 1920 | 15 CENTS A COPY 20 CENTS IN CANADA

Dutch Cooling Towers of Concrete

WHERE the electrical generating station is without an adequate supply of natural fresh cooling water, cooling towers, playing the same part in the station economy that the radiator plays in the operation of the automobile, are an essential. So vital to economical operation is successful cooling that a Dutch authority, writing in *The Electrician* (London) estimates that for every degree Fahrenheit drop in the temperature of the water ejected from the towers into the cooling system of the plant, steam consumption is reduced by one-third of one per cent. This makes it clear that the initial cost of cooling towers is a matter of small moment, since the attainment of high efficiency means that any cost likely to be incurred in construction will be regained through operating economies well within the life of the towers.

But notwithstanding long experience there is still a great difference in the efficiency of existing cooling towers, and the guarantees given by the builders are often not attained and are sometimes unattainable for physical reasons. A thorough investigation into the performance of a cooling tower is instructive, for faults are often detected, and in many cases improvements can be suggested. As the conservation of coal is of the utmost importance, in these days attention may well be given to this subject.

Our drawing shows the cooling towers at the central station of the Dutch State Collieries at Heerlen. Their construction and internal arrangement were the result of investigations made with several cooling towers of first class firms. The wooden laths are not drawn to scale, because their smallness would make them difficult to discern. This design of tower is an attempt to balance resistance to air flow and maximum cooling surface. The sketch shows how by a suitable arrangement of the lath the air passages were made as free as possible. The dry and wet bulb thermometers show that the air emerges almost saturated and sufficiently heated to cause a good draught. Many other cooling towers give too much resistance. The saturation with water-vapor and the heating of the air not immediately in touch with the falling water, are caused by diffusion and by the whirling of the air. The splashing water and the passages through the laths make it an easy matter to moisten and heat the air throughout. But it is very difficult to get an almost even temperature of the air on any spot above the timber hurdles.



The latest cooling towers of concrete, showing one tower under construction and partly broken away to reveal the interior structure, and another completed

As it was not possible to make the stream lines of air equal in length, uniformity in the conditions of the heated moist air over the whole surface of the cooling-stack was obtained by increasing the density of the spray from the center to the periphery. The radially placed gutters are slightly inclined, and the pitch of the spray nozzles is made smaller at the outer rings than at the middle rings.

The maximum cooling capacity is acquired only by adjusting carefully the dispersion of the sprinklers. Some inequality is unavoidable in heavy gales. But in this respect the cooling tower of circular section behaved well enough, and it was found that with large towers the best results were obtained when the radial screens, which as first designed divided the tower into sections, were removed. A cooling tower requires frequent and regular supervision. This must be effected by means of the dry and wet bulb thermometer. A water softener of ample dimensions must be installed when only hard water is available, and the collecting tank must be emptied and the water renewed at least once a year. The lath work of many cooling towers has collapsed through becoming covered with deposit.

A cooling tower is an hydraulic apparatus, and therefore it cannot be much overloaded. The cooling towers described in this article are each rated 6,000 kw., or 550,000 gallons per hour. The gutters are normally filled to about two-thirds of their depth, and as the water level rises with the square of the discharge through the nozzles the cooling tower can only be overloaded 25 per cent before the gutters overflow. The maximum capacity of the tower represented is about 700,000 gallons per hour. It is quite possible to overcharge a cooling tower much more than this, but the overflowing of the gutters is very bad for the efficiency.

As wooden cooling towers have a lifetime of only 15 years, and even in this space of time require many repairs, and as the initial costs and the expenditure on the upkeep of steel towers are prohibitive, the only material appropriate for cooling towers is reinforced concrete. The cooling towers represented in the illustration are constructed on the principle of an eggshell. Instead of supporting the dead weight and providing for resistance against the pressure of the wind by means of separate supports on the outside or the inside of the walls, or by beams, buttresses or other reinforcements, the wall is of double curvature, which withstands the pressure of the wind and supports the dead-weight by itself. The reinforcing rods are placed according to the straight describing lines of the hyperboloid and therefore require no bending. The construction although built with a minimum of material is of unexpected rigidity and strength, and therefore hardly more expensive than a wooden tower of about the same principal dimensions.

New Plant Foods

DURING a recent meeting of editors of agricultural journals, held in Washington, the Department of Agriculture placed on exhibition specimens of edible plants which the department has introduced into this country and which have now passed from the experimental stage of culture to a permanent position among American crops. The fruits and vegetables exhibited, all of them grown in the United States at Government stations, included cassava root, dasheen tubers, udo shoots, passion fruit, white sapote fruit, chayotes, and a number of highly colored and extremely fragrant varieties of mango. A majority of these plants can be grown only in the South, but should make their way into northern and western markets. The department states that the udo, a celery-like shoot from Japan, is now grown successfully as far north as Nova Scotia. It is a salad vegetable, quite novel in taste and texture to Americans. The Department's activities in extending the range of crops must in the long run be of extreme value.

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The object of this journal is to record accurately and lucidly the latest scientific, mechanical and industrial news of the day. As a weekly journal, it is in a position to announce interesting developments before they are published elsewhere.

The editor is glad to have submitted to him timely articles suitable for these columns, especially when such articles are accompanied by photographs.

How Many Miles to the Gallon?

WITH the gasoline situation that exists today, it is surely not too much to ask that every driver, if not for his own sake then for that of others, take all reasonable precautions to bring his gasoline mileage up to par, or even a little above par. The question of the operating economy as it affects the pocket-book of the individual owner in many cases seems an object hardly worth striving for. But quite aside from this is the effect on the general situation. It seems no remote cry to the day of gasoline rationing, when each car-owner may be told that he can have just so much gas and no more—that day has already found temporary place in the California calendar. Alike as a matter of valuable practice against the possible day of rationing, and as a means of postponing that day, everybody ought to seek the summit of gasoline mileage for his car.

Without disfiguring this page with unprovable assumptions and dry arithmetic, it can be calculated on an eminently reasonable basis that if every driver increased his mileage by a mere ten per cent, there would be enough gasoline saved to run about two-thirds of a million cars throughout the year. Twenty-five or fifty or even a hundred gallons unnecessarily burned in the course of a year by the individual driver is not going to make or break anybody, even at forty or fifty cents a gallon; but gas enough for two-thirds of a million cars might well make or break the automobiling community. That the good performance cuts the gasoline bill is immaterial—what we are driving at is to cut the demand for gasoline. There are many ways in which intelligent operation can do this. The thing is largely in the hands of the man who handles the throttle and the pedals. Most motors carry an unnecessary load somewhere. Brakes that drag, as shown by their being hot after the car is allowed to coast to a standstill; a motor so stiff that it will not rock freely when cranked by hand with a close throttle; undue friction in the running gear as shown by a car that is hard to push—all these things consume power, and have been known to raise gasoline consumption nearly one hundred per cent.

Then there is scope for much care in keeping the motor in good operating condition. Leaks past the piston or leaky valves allow a respectable fraction of the power to escape. A cylinder that does not fire wastes one-twelfth of the gas in a twelve; it wastes one-quarter of the gas in a four. Loose joints in the complicated series of connections that lead from the piston to the rear wheels do not waste power in such large blocks, but they waste it, be sure of that.

Carburetor adjustment is something of which many drivers know next to nothing. It is true that an over-rich mixture gives better acceleration, but at a ruinous price, not merely in the direct consumption of fuel but indirectly through the deteriorating effect on the engine. It is unfortunate that a rich mixture must be used for starting and until the motor warms up; but do not make the carburetor adjustment permanently rich to take care of this. You are given a carburetor dash control to cover this very ground; use it. Make an economical adjustment of the needle valve with the engine warm; get the temporary rich mixture with the dash control.

Do everything possible to keep the motor warm while in use. The gasoline of the day will not vaporize into an explosive mixture unless the intake manifold is hot, and everything that contributes to this condition will help fuel economy.

A final point that escapes many drivers is the effect of unnecessary speed variation. We would not be interpreted as advocating reckless driving, but the fact is that every time you slow down with the expectation of speeding up again you are laying up a debt to the laws of motion which you must pay by burning gas. Acceleration burns up gas, deceleration means failure to get the most out of the gas you are burning during the period for which it lasts. So drive at a uniform speed, so far as feasible.

Wanted—A Proverb

SINCE our publication of the details of the Michelson-Morley experiment, we have had a number of communications from our readers, asserting in more or less positive terms that this experiment proves nothing. The argument runs about like this:

Suppose a swimmer or a rower make a return trip upstream and down, contending with the current as he goes up and getting its benefit when he comes down. Obviously, says the self-appointed critic, since the two legs of the journey are equal, he derives exactly as much benefit from the current when he goes with it as he suffers handicap from it when he goes against it. So the round trip must take exactly the same time as a journey of the same length in still water, the argument applying equally in the case where the "swimmer" is a wave of light in the ether stream.

It seems extraordinary that so many people able to take an interest in the Michelson-Morley experiment and the Einstein theories should be ignorant of the fundamental principle here involved. We had at first doubted that this was a subject worthy of discussion on this page, but the extent of the misapprehension has resolved this doubt. So let us look at a numerical example.

A man can row in still water at four miles per hour. He rows twelve miles upstream and back, in a current of two miles per hour. At a net speed of two miles per hour he arrives at his turning point in six hours. At a net speed of six miles per hour he makes the downstream leg in two hours. The elapsed time for the journey is eight hours; in still water he would row the twenty-four miles in six hours.

If we were to attempt an explanation of this result in words we should say that by virtue of the very fact that it does delay him, the adverse current prolongs the time during which it operates; while by virtue of the very fact that it accelerates his progress, the favoring current shortens its venue. The careless observer realizes that distances are equal between the two legs of the journey, and assumes that times are equal.

If the journey be made directly with and directly against the stream of water or ether or what not, retardation is effected to its fullest extent. If the course be a diagonal one, retardation is felt to an extent measurable as a component, and depending for its exact value upon the exact angle of the path. Felt, however, it must always be.

The primary purpose of this editorial, of course, is not to correct this misunderstanding—greatly as it may call for correction. Those who have been in ignorance of the phenomenon just demonstrated necessarily lack any knowledge of algebra, since we are acquainted with no text in the elements of that subject which does not contain problems revolving about swimmers and rowers, or in late years aviators flying with and against the wind—problems which involve this principle and which cannot be solved without its application.

With the man who asks us to explain the Michelson-Morley experiment to him, because so far as he can see it is incapable of giving a positive result under any conditions, we have all the patience which his desire for enlightenment demands. We should think he might improvise a numerical case that would enlighten him, but if he can't or won't we are quite ready to do it for him. But with the man who from the depths of his ignorance calmly informs us that the Michelson-Morley experiment is foolish, that the eminent scientists who originated it and those who have repeated it after them and those who have used it as the basis of their theories and their teachings are simple-minded—that the whole world of science is chasing a shadow—well, when this happens we feel the inadequacy of the proverb about fools and angels.

Will not someone present us with a brand new pearl of wisdom to cover this ground?

The Psychology of the "Rider"

AT a point which we shall not try to localize in the development of our governmental procedure, the astute gentlemen whom we are in the habit of sending to represent us in the legislative halls made a scientific discovery of great importance—to them. Reduced to its simplest terms, this is it: If you have a piece of legislation which you know is vicious or predatory or in any way questionable to the extent that its passage on its merits seems difficult, hook it on to some general bill of importance in the form of a "rider." It will then in all probability come through with flying colors.

That the general bill thus utilized has nothing to do with the subject of the rider is understood. That the practice of thus jamming through legislation which shrinks from scrutiny is reprehensible will not be questioned. That this practice is on the wane we think will be admitted, in spite of recent riders which have attracted wide attention. But in any event, our interest here is with another point.

It would seem a reflection upon legislative intelligence to assert baldly that a measure which could not pass on its merits could be passed if tucked away in the bowels of the general appropriation bill. Yet experience has shown this to be a fact. Why?

Doubtless the reason is a complex of numerous legislative emotions and desires. In the first place, there will be members who want to vote for the measure which is thus disguised, but who are not sure that their constituents will stand for it. These men feel, and experience justifies them in this, that their vote on the general bill will not stand as a specific record of their attitude on the question of the rider, a record which may rise to harass them during the period immediately preceding the first Tuesday after the first Monday in November. To an extent this is a reflection upon their constituents; to this extent their constituents have earned such a reflection. But the constituent may be excused if he takes the attitude which probably accounts for the greatest number of votes in the legislative body itself.

There is always a good number of members who have steered a general bill through the perils of committee and floor. Their efforts are not centered during this struggle in keeping the bill intact or free of extraneous matter—they are well pleased if they can preserve enough of its original form to be recognizable. And when it finally sees the light of the open house and comes to vote, they and many others swallow the rider, fearing that if they did not do this the main bill might not fare so well in its essential features on going through the mill a second time. Few legislators indeed will sacrifice what they want for something that they don't want; and on the whole the constituency is of the same mind.

We must not forget, either, that the support of a rider comes always from those who are actively and materially interested in its passage; while the opposition usually is a matter of principle, and far less vigorously prosecuted. Then on a close line-up over the big bill, the votes of the supporters of two or three riders might make all the difference between passage and rejection.

The committee system affords another reason for introducing legislation in the form of a rider. The committee to which a general bill goes may have the necessary majority to report the rider, where the committee to which the minor measure would go if introduced as a separate bill lacks that majority. And if the rider is really vicious but looks innocent on the surface, it is less likely at the hands of the busy general committee to get a thorough discussion that will expose it. So when we have considered all the possibilities, it turns out not to be at all surprising that riders succeed where special bills fail; and the fact that today riders get more and more pitiless publicity, that more and more often they fail, is really an indication of considerable advance.

Electricity

Our Radio Stations are steadily growing in number. According to *The Wireless Age*, the Government shore radio stations number 135 of which 88 are in continental United States, 20 in Alaska, 19 in the Philippines, 3 in the Canal Zone, 2 in Hawaii, and one each in Porto Rico, Guam and Samoa. The Government ship stations total 470.

Wireless Research in India.—Upon completion of the research work, which is being done in India by a staff of scientists in order to find means of overcoming the meteorological obstacles which interfere with the proper working of wireless telegraphy in India during certain seasons of the year, there will be a great extension of the wireless system in that country.

Combined Ceiling and Reading Light.—An ornamental lighting fixture with a center light that may be pulled down close to a table for use as a reading lamp has been developed by a Western concern. Ordinarily the fixture has the appearance of the common four-light fixture, but the center lamp has a flexible cord wound on a reel in the fixture which unwinds when the lamp is pulled down.

The Use of Induction Motors.—The fusing of an alternating current motor should be determined by the normal running current, and should be regulated by the starting fuse, if such fuse does not exceed the normal running current by a certain specified amount, this value to be somewhat below the maximum current at which such motor may operate for an indefinite time; and it is also regulated by overload releases, and by time-limit circuit-breakers. The wiring and the fusing are separate problems.

Night Landing by Means of Radio.—Wireless calls for aid sent out by a Government mail plane which faced a descent in the dark, enabled the plane to make a safe landing, according to *Wireless Age*. Delayed an hour by a wind storm on the last lap of a journey from New York to Chicago, the radio operator on the plane sent out calls while approaching Chicago to light the landing field and prepare for the machine's descent. The message was picked up by the wireless operator at Great Lakes Naval Training Station and on several amateur wireless outfits and relayed to the landing field by telephone. The plane, which carried three passengers and 1,200 pounds of mail, landed at eight o'clock.

High Speed Wireless.—Manual operation is doomed as far as long-distance radio traffic is concerned. The ever-increasing cost of high-powered stations makes it necessary to handle a far greater volume of traffic than can be handled by the usual method. Thus some of the present transatlantic stations are operating at 50 words to 100 words per minute by means of automatic transmitters and receivers. In England experiments have been going on for some time with automatic transmitters capable of a normal speed of 450 words per minute, and even 1,000 words per minute during demonstrations. The recording is effected by means of a special electro-chemical apparatus. This apparatus consists of a specially prepared paper drawn between a roller and a marking pointer. The arrival of a signal causes a current to pass through the paper, producing discoloration.

Elimination of Insulator Failures.—In a recent issue of *Electrical World*, Mr. E. J. Kallevang describes methods of detecting faulty insulators, and notes the fact that insulators that have been stored several years are found to have deteriorated. This deterioration may be due to mechanical stresses or to the electrical test that has been applied at the works. It is observed that insulators near railway tracks break down readily. This is supposed to be due to sulfur fumes, which may attack the cement and promote crystallization. It is also suggested that in such cases the insulators may reach higher temperatures due to their blackened surfaces. Methods of testing by the oscillator or by the megger are described. It is believed that the higher percentage of failures in the top unit in suspension strings is due to the fact that it is subject to more abrupt changes in temperature. Trees which are near the line, or overhang it, are a frequent source of damage.

Science

The International Research Council.—A report of the proceedings of the first meeting of the International Research Council, held in Brussels in July, 1919, has been edited by the secretary, Sir Arthur Schuster, and published in London by Messrs. Harrison & Sons.

Thefts of Platinum.—It is said that organized thefts of platinum are taking place throughout the United States. The matter has become so serious that, at the suggestion of Dr. W. F. Hillebrand, the American Chemical Society has appointed a committee to consider whether legislation may not be recommended to Congress with a view to dealing with the situation.

The Norwegian Geophysical Commission.—A new body known as the Geofysiske Kommission represents a union of Norwegian institutions and explorers in the domain of hydrography, terrestrial magnetism and the study of the aurora borealis. With the aid of funds granted by the Norwegian Government the commission has begun publishing a series of memoirs, *Geofysiske Publikationer*, in English, French and German.

Recent Surveys in Spitsbergen.—A systematic survey of Spitsbergen has been carried out annually by the Norwegians since 1906. During the year 1919 a party of surveyors, hydrographers and geologists, headed by Adolf Hoel, mapped a total area of about 520 square miles, and made hydrographic surveys over an area of about 1,620 square miles. A chart recently published by the Norwegian Hydrographic Office, of the Arctic Ocean from Norway to Spitsbergen, embodies the results of the hydrographic surveys of the Spitsbergen coasts down to 1918.

Weather Forecasts by Wireless Telephone.—The distribution of weather reports and forecasts by radiotelegraphy has made great progress since the war, and is no longer intended primarily for the benefit of mariners. The wireless telephone also has recently been pressed into the service of meteorologists. Arrangements have now been made so that the weather forecast sent out by this method every day at 10 A. M. from the Physics Department of the University of Wisconsin can be received, with suitable apparatus, anywhere in southern Wisconsin. A U. S. Weather Bureau station is located at the university.

Anthropology of Polynesia.—Dr. Henry Fairfield Osborn has recently called attention to the urgent scientific reasons that exist for immediately taking up an energetic and systematic study of the anthropology of Polynesia; one of the undertakings that will, it is hoped, be set on foot by the forthcoming conference in Honolulu on the problems of the Pacific. Dr. Osborn states that the material for such an investigation is disappearing with almost incredible rapidity. The ravages of influenza during the past two years have swept away a large part of the members of the Polynesian race. The survivors on certain islands constitute a very small percentage of the original population. Researches on the physical anthropology of the Hawaiian group have recently been begun as a co-operative enterprise of the Bishop Museum of Honolulu and the American Museum of Natural History of New York.

Fungi That Damage Canvas.—Major W. Broughton-Alcock of the British Army has made some studies on the fungi that cause black and brown spots on canvas tents, awnings, etc., and that bring about a more or less rapid destruction of such articles. A note on the subject by J. Ramsbottom appears in *Nature*. The investigations were carried out partly in Malta, where, it is said, awnings last only about a year. The principal destructive agents in the case of cotton- and flax-made canvas were found to be *Macrosporium* and *Stemphylium*. The variation in the color of the spots is found to be due to the presence of various other fungi in association with the genera above mentioned. The first signs of fungoid growth appear on the inner side of the roof portions of tents and marquees. Often within three months pressure on the spots made by the fungi leads to perforation, or a strong wind causes tearing. Experiments showed that the Willesden (cuprammonium) method and cutch treatment prevented the growth of the fungi.

Automobile

Motor Farming Suits Italy.—Italy has disposed of about all of the 6,500 farm tractors bought from the United States in 1917 and of a number purchased locally. In the meanwhile Italian farmers have learned the benefit of motor cultivation and will naturally continue to use these implements in large quantities. In 11 months of 1919 that country imported 8,114 metric tons of reapers, mowers, tractors and other farm machinery.

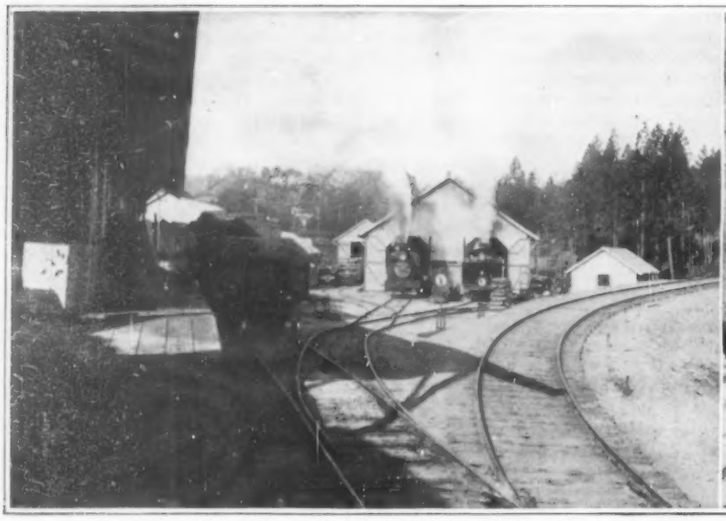
British Motor Tax Based on Road Wear.—The new taxes which it is contemplated, will be levied on motor vehicles in the United Kingdom, will be based on the amount of road wear, according to a statement of the Ministry of Transport. The horse-power will be the unit for the calculation of the tax on private motor vehicles, their weight the unit for commercial vehicles, and the seating capacity for hackney carriages and omnibuses. Motorcycles will be taxed on their weight with an added amount for sidecar or trailer.

A Windshield Compound.—Among recent automobile novelties is a liquid which is easily applied to a wet or dry windshield with cloth, sponge or tissue paper. The manufacturers claim that one application will keep the glass clear for 12 to 24 hours, through the most severe storm of rain or snow—no matter how hard the rain, hail or snow beats, it will not stick. The advantage of this over the more usual methods of keeping the shield clear is that one does not have to remove one hand from the wheel while driving. The makers emphasize that the substance is not a grease or a soap, but a chemical compound quite different from either of these classes.

New German Self-Starter.—A description of a German self-starter which is in reality a device for filling the firing cylinder with a strong mixture so as to permit of a starting on the switch—for use with the Bosch self-starting coil—has appeared in a recent issue of a German automobile paper. A supplementary jet is attached to the carburetor, and gas is drawn by means of a hand-pump and forced through a small chain-driven distributor to the required cylinder. The fixture for the cylinders consists of a Y adapter, one arm containing a non-return valve through which the gas is forced, and the other arms containing the sparking plug. The advantage claimed by this device is that it can be fitted to almost any existing motor at very little expense.

Easily Located Carburetor Troubles.—When an automobile engine, after starting, runs for a minute or two and stops, the first place to look for the trouble is the gasoline feed line. A partial stoppage in the fuel supply pipe will lessen the flow of fuel so that the float chamber fills slowly. On being started, the engine will quickly consume the gasoline in the chamber and stop. Another possible cause for the fault is the float sticking, and if the float sticks in the high position the flow of fuel will be greatly lessened or may be stopped entirely. Water in the gasoline is also troublesome as a drop may get into the feed pipe or the spray nozzle and interfere with prompt starting or reliable feed of fuel. Lint or other foreign matter around the filter screen in the feed line is also responsible for restricting the fuel flow, especially in cars using the gravity feed system.

One Truck Hauls More Than Seven Teams in Road Contracting.—An interesting comparison has been made in a recent number of the *Oklahoma Highway Bulletin* with regard to teams versus motor trucks in the hauling of road building materials. A road contractor while doing state aid road work of hauling crushed stone, employed seven teams, seven drivers and one 3½-ton motor truck. The seven teams had each hauled three loads of 1½ yards per day, a total of 4½ yards daily. By motor truck he hauled 33 yards each day. Figuring the cost of each team and driver at $7.25, the total amount was $50.75 per day for seven teams. The 3½-ton motor truck actually hauled more material each day than the seven teams. The operating expenses of the motor truck figured to $18.40 per day, thereby effecting a daily saving of $32.35. The distance of the haul was 4½ miles each way, or a total of 9 miles.



The yards of the Hetch Hetchy Railroad at Groveland

Full train of locomotive, flats, gondola, box-car and caboose

Building in the Wilderness

Where the Engineer Has to Lay Down a Railroad to Take Him to His Job

By A. R. Surface

THREE hundred thousand tons of construction material is the amount estimated as necessary for the Hetch Hetchy Dam and other work connected with the Hetch Hetchy water supply enterprise of San Francisco. A large part of this must be carried far into the foot hills east of the city—far enough in fact to attain an elevation of some 3,500 feet above the sea in a valley location. The great dam, the principal item of the whole work, is to be located there in the Sierra Nevada many miles from the nearest ordinary railroad. The intervening country is very difficult to traverse; so that one of the serious problems that had to be faced was how to get the enormous tonnage from an existing railway to the points of use notwithstanding the difficulty of the topography. Naturally, there were two alternatives—a road adapted to heavy motor trucks and tractors, or a railroad. The second was the one chosen. The location survey was completed just about five years ago.

It may surprise some that it was decided to build a railway rather than an ordinary road. It is a matter of calculation. The report of the chief engineer, Mr. M. M. O'Shaughnessy, five years ago was to the effect that 233,000 tons of equipment and material would call for transportation. It was estimated that the cost of hauling by motor truck would amount to $3,095,000 and that the expense by the railroad method would be only $2,010,000. From the point of view of the water-supply project alone, a saving of $1,085,000 would be effected by the railroad. Apparently, the amount of material estimated as necessary has considerably increased since that early date; so that the saving is to be set higher yet. In addition, the transportation is to be viewed as rather likely to be more rapid with the railroad. Further, such a road would earn something from outside freight and from passenger service, and would remain at the end a very considerable asset. However, there is a point which needs to be added. At the time of the estimate it was considered necessary to use double sacks with the cement when transported by motor wagons. As a very large percentage of the total freight would consist of cement, the extra expense of 11 cents per unit constituted a heavy debit against the motor truck. The estimated cost of the railroad seems to have been considerably in excess of the actual expense, as the contract was let for $1,543,080.74.

The Hetch Hetchy Railroad connects the site of the great dam with the immediate vicinity of Rosasco which is a station on the Sierra Railway of California. Between the two terminals, Hetch Hetchy Junction and Damsite, are 68 miles of standard-gage track. Here is a very considerable little railroad, built primarily as a means of constructing something else. Doubtless, the road will be maintained after all construction work on the great project is completely finished. This construction railway is a real railroad and not a pretense nor a freak. There is no grade amounting to more than 4 per cent but the curves are sharp.

The general direction of the road is east and west, though naturally it winds about in order to take advantage of topographic features. At the Junction the elevation above the sea is 935 feet, but the line drops to 625 feet soon after leaving this terminus. This drop is made in the course of but 9 miles of track and has of course to be later on recovered. The object in view was to get across the Tuolumne River, the very stream which in fact forms the foundation of the water supply project. This river is subject to floods, but the bridge carries the track over at 12 feet above high water. Once on the other side of the stream, the railroad naturally stays in the valley; but it does not always cling to the river itself. In order to get uphill and downhill without excessively steep grades and without heavy expenditures on construction, it was found necessary to use sharp curves and plenty of them. The gentlest curvature round bends is 30 degrees while there are numerous curves in the range 18-26 degrees. The curves if put together and arranged in one circular direction would yield nearly 100 complete circles. The most considerable elevation attained is 5,064 feet at Poopenaut Pass. This is a good deal higher than any regular railroad attains in passing over the Appalachians in the eastern United States. The road is 50 miles long from where it crosses the Tuolumne until it reaches this highest point, so that the 4,439 feet of difference in level is attained at the average rate of about 88¾ feet per mile. On the western side of the pass the descent is pretty steady on heavy grades until Damsite is reached, where the elevation is 3,869 feet above the sea. The drop of nearly 1,500 feet is accomplished in 9 miles, or at the average rate of about 166 feet to the mile.

This road in the mountains had to cut its way largely through real rock. Of the 1,000,000 cubic yards of excavation more than half was in rock. Naturally, there are many ravines, little valleys and little canyons that are crossed. In general, timber trestles and the like were employed. Some 500,000 board-feet or more were consumed in this work.

The subgrade of the roadbed is, for the 59 miles from the Junction to the summit of the Pass, 16 feet in width. For the remaining 9 miles from Hog Ranch down to Damsite in Hetch Hetchy Valley, the width is 6 feet greater. When the railroad is no longer needed for the work at the eastern end, the track will be taken up and the roadbed resurfaced. There will be then left a fine road for automobiles.

Many of my readers will ride over this nine-mile stretch despite the fact that it is now occupied by railroad rails, cross-ties and ballast, for already the Yosemite Park Company is operating tours from Yosemite to Damsite. An ordinary motor bus brings the tourists to Hog Ranch—or, Mather as it is now more aesthetically termed—by travel over a route 35 miles long. From Mather down to Damsite, the conveyance is a special motor bus which runs on the railway track.

With a view to facilitating the work at the Hetch Hetchy Dam and of providing a means of turning trains, a loop has been added to the railroad at the eastern terminus.

A typical bridge along the line of the Hetch Hetchy road

Use of Rare Sugars as Medicine

THE so-called rare sugars are used to a considerable extent by the Medical Corps of the Army, and by the profession in general. One of the principal uses to which they are put is the differentiation of bacteria, for which purpose they are invaluable. For some time the Bureau of Standards has had presented to it for test a number of these rare sugars. Owing to the large demand for one of these sugars, known as d-Mannite, the Bureau has undertaken, at the request of the War Department, the production of a considerable quantity of this substance. The Bureau's investigation has finally developed a method whereby pure white crystals of d-Mannite can be produced by two crystallizations from the crude manna.

The Third Degree for the Baseball

By Edgar Lockhart

WITHOUT baseball lots of Jacks in America would be mighty dull lads. Without the National pastime, countless thousands of fans who now gain recreation and pleasure in watching "Babe" Ruth, "Ty" Cobb and other veterans of the diamond in their base-stealing or fence-busting specialties would be glum and disconsolate. Without this typically American sport our athletic initiative would be jeopardized. Baseball is our invention, our possession and one of our most fruitful resources for demonstrating to the world our athletic supremacy. And every American youth at one time or another does his best to sustain the prestige in which the great game is generally held.

A baseball for service and maximum utility must be adapted to withstand the shock of batting and at the same time must possess sufficient resiliency and buoyancy for flight and catching in the hands of the different players. The American baseball preëminently is a development from the English cricket ball. The English originally used a rubber composition ball and later a ball having a central core with a resilient layer or cover on the exterior. Finally a solid cored ball surrounded by filamentous windings was devised.

The next step in the ball line developed by ambitious inventors was the initial baseball which consisted of yarn wound on a resilient core and encased in a leather cover. H. A. Alden, Mattewan, N. Y., on December 17, 1867, was granted the first patent rights on a baseball which consisted of a composite of rubber, lead and cork with sulfur used to vulcanize the compound. Under practical service, this type of ball proved unsatisfactory with the consequence that its originator the following year turned out another model ball made of ground cork encased with cord windings and surrounded with a rubber compound cover. Later this ball—which proved fairly serviceable—was improved by the substitution of a leather for a rubber cover.

In the early history of the game freak balls were numerous, the prize innovation of this description being a ball with a bell as a core which rang when the ball was batted. This ball was invented about 45 years ago. Otherwise than as an asset to keep the players from going to sleep, this comedy baseball possessed no merit. However about the same period, patents which subsequently proved valuable were taken out featuring the use of a square reefing knot and the herring-bone stitch.

In 1883 B. F. Shibe devised the use of a plastic cement and an india rubber solution for holding together the core of the ball and the yarn wound upon it. This arrangement permitted the cover to slip on the ball when batted without in any respect damaging the interior. One of the latest inventions of Mr. Shibe—perfected during the last decade—gives to the best baseballs increased uniformity and rigidity of structure. He uses a central cork core and winds around it a layer of yarn and rubber, vulcanizing this to the desired degree of hardness and resiliency. Such a core permits of winding the yarn very tight and hence results in a better and more durable ball.

Horsehides imported largely from England and Russia—although during the war domestic baseball manufacturers had to depend largely on native supplies of skins—are used for baseball covers as well as for patent leather, uppers for shoes, thongs for whips and for sewing harness. Horsehides are tough, durable, wear well under rough usage and are capable of with-

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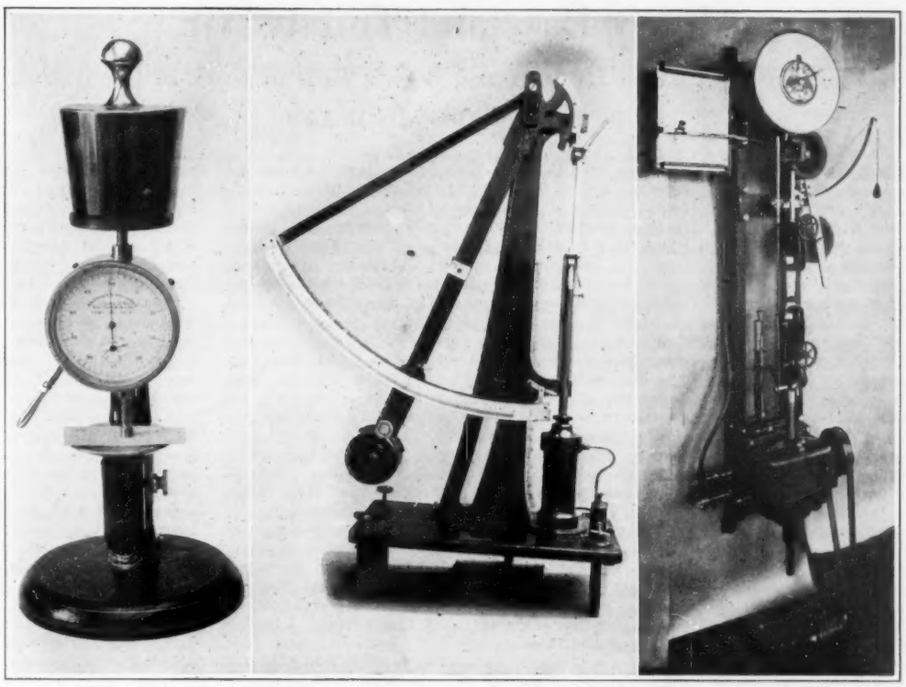

Left: The instrument that measures resiliency. *Center:* Apparatus for determining the tensile strength of the yarn used for stitching or winding. *Right:* Machine that tests the force necessary to rip the stitches out of the ball—something quite different from straight tensile strength

How the Bureau of Standards separates the sheep from the goats of baseball manufacture

Handling High Voltage with Bare Hands

By George Gaulois

FOR many years there has been no startling improvement in the method of working high voltage lines. Year by year there has been a constant tendency toward increased voltages. The quality of line materials has kept pace with the requirements of up-to-date line construction, but little thought has been given by the electrical fraternity to the urgent need of better and safer equipment for maintaining the line in a high state of efficiency.

It has remained for an American engineer to introduce a new method of working on high voltage circuits, which makes it unnecessary to shut off the power for protracted periods with the resultant inconvenience to electric power users. This method consists of putting the protecting insulation not between the man and the line, as has been done in previous efforts to attain the desired result, but between the man and the ground, thus eliminating the cumbersome, long-handled insulated tools which have heretofore been used on live wire work. The problem has been one of securing the proper insulation, and this problem has been solved in the safety staging which is shown in the accompanying illustration, and which forms the cover subject of this issue.

The safety staging, made of carefully selected hard wood submitted to a special drying and impregnating process, has been on the market for some time. It is only recently, however, that this treatment has been perfected to a point where the designer has felt justified in eliminating all insulated tools and allowing the men to work direct on the live line with bare hands. With this staging properly placed, which is but the matter of a few minutes, the man enters it and by so doing interposes between himself and the pole (or steel tower) an insulating medium capable of withstanding over one hundred thousand volts. Guards are so placed as to prevent any possibility of accidental contact with a grounded arm, guy wire or another phase of the circuit.

The man working on the safety staging is free to touch the live wire at any time. In grasping the line there is no discomfort whatever to the man, although there is a slight "pip" similar to a static discharge.

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Left: High-voltage crew with complete safety staging outfits for working on live high-voltage lines. Right: Placing the safety staging preparatory to changing a string of disk insulators on a 33,000-volt live wire

Muggy Days and Thirsty Air

The Mechanism That Keeps Us Cool, and Why It Fails to Work in Damp Weather

By Professor Alexander McAdie

IN the SCIENTIFIC AMERICAN for May 29, 1920, a leading editorial of rare literary charm describes the paramount importance of water. We are shown how all modern engineering depends in the last analysis upon the successful handling of some water problem; and that "by far the greater portion of the human struggle for collective existence hinges on the control of water, keeping it out of the places where it is not wanted and insuring its presence in those locations where it is desired." It is free to flow, it freezes, it melts, it fetches and carries; it is at times the most docile of servants and again it breaks all bounds and spreads destruction far and wide.

There is just one other substance that is as important to man's welfare, and that is *air*. Man quite early in his career attempted with success the mastery of water; but not until our own day have engineers been called upon to master air. They now put it to work, and in the pages of the SCIENTIFIC AMERICAN one can read of many practical applications: carrying heavy bricks, as well as light cotton; sucking coal from the bunkers on the destroyers; cooling the wireless spark; revitalizing the air in engine rooms; ventilating the kitchen; operating the laundry; under pressure digging a way beneath river or through rock bed.

Geologists tell us that in arid regions the erosive power of the wind, that is, the unharnessed sand laden air, changes the face of nature more than the washing rains; and that the action of air is more extensive and persistent than the action of water. What then of the combined effects of water and air upon those who walk the earth and breathe the air? Here is a problem in human engineering; and a problem that concerns us all as no other ever can.

The Water in the Air

Air carries water in the form of vapor, as well as in the liquid or solid form. And so while it has been customary to speak of the *capacity* of air for vapor, and in a way we might describe this condition as air *thirst*, we of course realize that the air itself has no real capacity for vapor, and that the quantity of vapor present is not a measure of any physical property of air any more than a quantity of air in water would be an essential part of the water. Like man and wife, air and water vapor pass as one, and in many problems we deal with the combination or mixture; nevertheless each is an entirety, each has its own characteristics. But it makes a vast difference in our feeling of comfort whether the load of vapor which the air carries be light or heavy and whether the temperature at the time be high or low.

There are days, muggy days we call them, when no one is comfortable. Even the best natured of our friends are uneasy; if not indeed fretful. We are all irritable and we know not why. On another day, things are different and we regret and wonder at our crossness. Oh, for the engineer that will regulate, not indeed the weather, but the essence of all weather, the load of water vapor which the air carries. Then all of our days will be days of maximum comfort and minimum irritability. John Hay wrote of such days, calling them Castilian days, days of quiet charm and perfect rest; and probably he was entirely unaware of the fact that with a heavier load of water vapor and higher temperature those same days would have been transformed into the trying, muggy hours of our mid-summer climate.

One Castilian type of day occurred on Easter, April 8, 1917. The relative humidity at Blue Hill Observatory went down to 2 per cent. In the records for 35 years we have not found so dry a day. Possibly it was the driest day in a century. Some rather precise measurements showed that in every five cubic meters of space there was only one gram of water vapor, when ordinarily there would be one hundred grams. The weight of water vapor present is not the relative but the *absolute* humidity; on this date both were extremely low. It was a pleasant day—although there was a state of air thirst that a full-fledged simoon might equal but could hardly surpass.

It was not a chinook wind or foehn effect, however, where dryness is due to a previous robbery of the moisture from the air. We cannot clearly identify the robbers; we are unable to say where the air was originally lifted and, following expansion, cooled; and a certain amount of water vapor abstracted. Somewhere, far to the west, probably beyond the Mississippi, the moisture was stolen; and the dry air moving slowly to the southeast, was dynamically heated, chiefly by horizontal compression. Air rising loses its load of vapor because the cooling brings about condensation and the water drops out. Air falling generally becomes warmer and drier because its thirst is greater. And for reasons which are given later we can stand warm dry air much better than warm wet air. Indeed there is a direct relation between health and humidity when the temperature is high; and we may even go further and connect happiness and certainly personal comfort with humidity and heat; or in more exact terms comfort is a function of evaporative cooling which in turn depends largely on humidity.

An interesting example of the above relationship can be found in the studies of relative humidity made during the early months of this year by Ellsworth Huntington at Boston hospitals. It seems that in surgical cases the recoveries were more pronounced when moderate humidity and temperature followed high humidity than under other conditions. And what is true for the sick and suffering may hold also for the well and strong in that the sum total of health and happiness may be increased if we can only control the moisture and heat environment. In this control there are three prime factors, ventilation, transpiration and stimulation.

Of these ventilation is perhaps most clearly recognizable in its results, and it is also within our power directly to control it. Let us take so simple a problem as the ventilation of a school room or assembly hall and follow the reactions on poor mortals, as the air thirst varies.

THE good old bromide, "It isn't the heat as much as it is the humidity," is familiar to all of us. No argument is needed to convince us that a damp hot day is more disagreeable than a dry hot day. Yet to many of us this must have been a good deal of a puzzle. Water, especially cool water, is a universal cooling agent. The moisture present in the atmosphere on a thoroughly uncomfortable muggy day often is distinctly cold and clammy, so that in the moments when we cease steaming we feel the premonitory symptoms of a checked perspiration and an oncoming cold. Yet this moisture doesn't cool us. Why? Dr. McAdie answers this question, pointing out that when the air is saturated it cannot take up our perspiration, and that when we have perspiration without evaporation, nature's process that is designed to make us cool acts only to make us more uncomfortable than ever.—THE EDITOR.

The True Rôle of Ventilation

Ten years ago Dr. Gulick, for the Russell Sage Foundation, raised the question whether the air in school rooms directly or indirectly caused the fatigue and lowered vitality so frequently noticed. Was there a subtle poison, such as carbon dioxide or carbon monoxide, or was it lack of oxygen, or was it too much humidity? As finally phrased by the physician, the problem read: "Does anyone know in what respect our present schemes of ventilation are wrong? Why do delicate children and tuberculous persons get well out-of-doors, and fail to do so indoors, and what do we need to do *to make indoor living as healthy as outdoor living?*" (The italics are ours.)

This is a challenge to engineers, especially ventilation experts, also to chemists, physicists and physicians. All are directly concerned. The mental attitude of the various professions to the problem is most interesting. The engineers, for instance, hold that while the problem has a dual nature, being partly engineering and partly hygienic, the engineering part has all been attended to; but the hygienic part, if we may use the words of a very distinguished engineer, "is in very poor shape. It is up to the doctors and not for the engineers to settle." Meanwhile the physicians think it is essentially a question of sufficient supply of fresh air, and therefore an engineering problem. The chemist holds that there are no poison gases in the air, or not enough to produce the results described. The physicist harbors the suspicion that the ventilation experts are not up on the physics of saturated and unsaturated space; that while blowers and fans may furnish enough air, the effect of air thirst has not been sufficiently studied.

The older notions about poisoned air due to exhalations from the body, have been given up. Carbon dioxide was the particular gas which was held responsible and while there is no doubt as to its toxic character there is too little of the gas present, to prove injurious. Under usual conditions, outdoor air contains only three parts in ten thousand of this gas. The specifications for nearly all modern school buildings call for air renewal at the rate of a cubic meter per hour per pupil, and under such conditions the carbon dioxide limit will never be reached. So we may dismiss the poisoned air explanation. But even the best specifications are silent regarding the *thirst trait* of the incoming air, that is, its evaporative and cooling capacity and presumably its vitalizing- or comfort-bringing power.

Let us at this point, correct the story, as it is commonly told, of the Black Hole of Calcutta, and show that it was not poisoned air which caused the death of 123 of the 146 prisoners; but high temperature and a minimum air thirst or saturation. The night was hot, damp and still. There could be no cooling of the skin by evaporation, and profuse perspiration without evaporative cooling meant only extreme discomfort. Fatigue and exhaustion of the sweat glands caused death.

How different was the experience of the soldiers in Mesopotamia during the recent campaign. The heat was intense but the thirst of space for water was very great. Perspiration quickly evaporated and the skin temperature, or *sensible* temperature, was lowered. All that was necessary was to drink enough water. In cases of heat stroke (for these did occur) wet sheets and spraying were resorted to, as substitute sweat layers; and in nearly every case, a marked reduction of temperature and recovery followed.

It seems actually probable that by means of an artificially wetted skin, the traveler in the desert can protect himself against that scourge of the desert, the simoon. There is no poison in the air, as the old books maintain, but just sand and a great air thirst. The air is heated and like a blast from a furnace desiccates. The simoon parches and shrivels; hence the traveler must keep his skin continually moist, or his body becomes heated above the critical temperature.

Will not some ingenious son of the West devise an evaporating mask and an automatic moistener for the traveler over the parched sands? The Arab kneeling and covering his face only half-way protects himself. He could add to his safety by using a damp towel.

With a full appreciation of the psychophysics of the problem we may nevertheless omit consideration of the effects of sunshine, skyshine, shade and the never-ceasing mutation of color, motion, form and sound prevailing outdoors, compared with the monotony of indoors, and come directly to the conclusion that the prime physical difference between fresh air, so-called, and foul air, lies in the water content or humidity, remembering that air thirst is a function of air motion.

The term relative humidity is widely used and little understood. In scientific words, it is the ratio of the pressure of the water vapor present to the pressure when space is saturated. It is a percentage and ordinarily 100 means extreme dampness, rain, fog or mist.

But even in physics, things are not always what they seem to be and relative humidity is no exception. We sometimes have rain when relative humidity is less than 100. What is more troublesome, relative humidity does not mean the same thing if the temperature varies. Thus two localities may be listed as having the same relative humidity but the actual dampness will not be the same. Asheville and Los Angeles have a mean relative humidity in January at 8 p. m. of 72 per cent; but at the former city the weight of the

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Radium and Its Works

How the Alpha, Beta and Gamma Rays Are Being Applied in Commerce and in Medicine

By Ralph Howard

IN view of the fact that there is not a pound of radium in the world, it seems rather useless to point out what could be done with a ton of this precious mineral; and yet the fact remains interesting that, according to the late Sir William Ramsay, the energy in a ton of radium, if it could be harnessed to human uses, would propel a ship of 15,000 tons with engines of 15,000 horse-power at a speed of fifteen knots an hour continuously for thirty years. It now requires a million and a half tons of coal to accomplish the same result. Even with the present high price of coal, however, the standard method remains cheapest, since the market value of radium is $3,260,000 per ounce.

General interest in radium and its manifold uses has been revived recently by two occurrences in New York State. The first was the exhibition of three grams of the purified element, worth over $375,000, to New York and visiting physicians at the last annual meeting of the New York Medical Society, held in the Waldorf Astoria Hotel March 23rd-26th. The radium there dislayed was mined entirely from American carnotite deposits discovered in the Paradox Valley of Colorado and in the adjoining districts of Utah. The second was the appeal by a group of scientists to the New York Legislature to appropriate $250,000 for the purchase of two grams of radium, for use in the treatment of cancers, benign tumors, skin diseases and certain forms of tuberculosis.

Along commercial lines the development of radium is proceeding by leaps and bounds. Luminous paint manufactured with radium has long been used for making luminous watch faces, compass faces, and radiolated signs. It has recently been applied also to such daily utilities as hospital call buttons, automobile and motorcycle speedometers, airplane and ship instruments, telegraph dials, steam gages, and poison-bottle indicators. An interesting application has been the manufacture of fish bait where a dab of radium at the end of the hook takes the place of live or artificial bait.

Other uses of daily convenience as well as of commercial importance include: electric-switch push buttons, gasoline gages, mine signs, house numbers, pistol sights, crucifixes, toy doll and animal eyes, electric flash-light locators, theater-seat numbers, key-hole locators, bedroom slipper buttons, door and furniture locator buttons, automobile steering-wheel locks, safe-combination dials, etc.

The therapeutic value of radium has been confirmed and extended in the last few years by a more accurate classification of the effects of the three kinds of rays which radium emits in the process of disintegration. The alpha and the beta rays, it has been found, are the heaviest; at the same time that they have the most pronounced curative effect, they have also the least penetrative energy, so that their chief use is against exposed cancers and diseases of the skin. The gamma rays, on the other hand, are the lightest and possess the greatest penetrative energy; but their curative effect is least pronounced of all. "The gamma ray is in effect a highly penetrative type of X-ray. It is capable of penetrating about eleven inches of solid lead; and of course the human body obstructs it scarcely more than a pane of glass obstructs an ordinary ray of light."

Hence adequate treatment by physicians of superficial malignant growths is accomplished primarily by exposing them to the alpha and beta rays; with deep-seated cancers, the healthy tissue is protected from the alpha and beta rays by a metal screen through which, as well as through the body, the gamma rays penetrate with ease.

The principles by which radium effects its curative work are of notable interest. In the first place, just as certain tissues have a peculiar affinity for certain stains and an antipathy to others, so radium works selectively. It attacks the diseased tissue more quickly than the healthy. Furthermore, a certain amount of irradiation actually stimulates the diseased cells, and makes them grow more successfully; but when that point has been passed, the effect of the radium is to over-stimulate the cells, with the result that they die of a form of fatty degeneration or necrosis. Precisely what the explanation is for these curious phenomena has not yet been determined, and it remains true to this day that in certain malignant growths, all possible amounts of irradiation stimulate the growth instead of checking it. The backers of the radium bank are hopeful, however, that further experimentation will do much to clear these points up.

While the expectation has not been entirely abandoned that radium may some day completely take the place of surgery in the treatment of cancers and allied diseases, its present use is mainly in collaboration with operations. It has been found that the combination is particularly effective, surgery being used as far as possible, with radium as a pre-operative or post-operative aid. In the treatment of facial cancers, radium is exceptionally important, since it leaves no disfiguring scars, otherwise sometimes so horrible as to be worse than the disease itself.

Correspondence

The editors are not responsible for statements made in the correspondence column. Anonymous communications cannot be considered, but the names of correspondents will be withheld when so desired.

The Muscle as a Motor

To the Editor of the SCIENTIFIC AMERICAN:

I would be very glad to have some enlightenment on the following matter: What is known at present about the animal muscular system viewed as an apparatus to convert kinetic (chemical) energy into mechanical power? The ordinary encyclopedial works of reference, at least those with which I am acquainted, give only very vague information.

The points I should like to obtain clearness about are the following:

1. The muscle produces *power* by its alternate contraction against resistance and subsequent relaxation. The amount of the power thus produced is considerable; its ultimate source is evidently the slow oxidation of food constituents after their incorporation in the blood. Now what intermediate stages are interposed between both terminals? Are these *heat, electric current, magnetism* or what?

2. Is the muscle itself a *motor* in the mechanical sense? i.e. Is the conversion of kinetical energy into mechanical power effected within the muscle itself or in some other organ—in the cerebral or nervous system? It appears to me probable that the first is the case and that the nervous system merely plays the part of a transmission or gearing.

3. Is there any remote chance or possibility to *construct a muscle motor* from ordinary non-living materials? In other words, would it ever be feasible, of course not without much minute study by anatomists, physiologists, chemists and mechanical and electrical engineers, to construct an *engine* of which the original source of power would be the slow oxidation by atmospheric oxygen at low temperature of several organic compounds such as carbon hydrates, fats, albuminoids, alcohol, etc., and in which power should ultimately be obtained in the shape of a *contraction* and *relaxation* of a system of complicated *contractible elements* made to emulate the action of the animal muscle?

I find in the well-known work of Dr. Ranke (Der Mensch) the statement that in the human organism about 1/6 of the total amount of heat of combustion of the food can be recovered in the form of *external mechanical power*. If this be correct it is not a bad output for any motor and possibly several other animals, more specially designed to produce power (think of swallows, seagulls, carrier pigeons, etc.) would give a much higher percentage. As to *power* in comparison with *deadweight* the human motor certainly is no record, a fact which accounts for man not having been able until now to fly by his own muscular power. Of course as man and even the lower animals have many other functions besides those of a motor it is not to be expected that in any living organism the theoretical limit as to fuel economy or lightness should be reached.

I think however that the swallow or the seagull might prove on investigation to be *engines* both *lighter* and more *economical* than even our modern flying motors, and if this should prove to be the case there would be I think every inducement for the engineer to try to adopt their methods for the conversion of energy.

For any information on this matter I will be very thankful. N. C. UOOGVLIET.

42 van Galenstroat, The Hague, Holland.

Cinders and Concrete

To the Editor of the SCIENTIFIC AMERICAN:

In the July 10th issue of your magazine a correspondent wrote of the danger of using "Cinder Concrete." I wish to add our experience, showing the positive folly of using cinder fill in the neighborhood of electrical conduits.

On account of new construction, it becomes necessary to remove a portion of the roof of one of the largest buildings in this city. In the original construction of this roof a six-inch layer of cinders had been laid on the conduits; then seven inches of concrete and finally several layers of roofing paper thoroughly tarred.

The conduits had remained in the cinders eight years only, and in many cases were entirely destroyed, leaving the wires exposed. It would have been impossible to renew or re-install any new wires in these conduits.

The remedy for this condition is to put a grouting of good concrete entirely surrounding the conduits, when the installation is made.

City Electrician, Omaha. ISRAEL LOVETT.

A Problem in Electrical Engineering

To the Editor of the SCIENTIFIC AMERICAN:

Will some reader kindly advise on the following: I am having great trouble due to burnt-out coils of generators during heavy windstorms on the hills at an altitude of 6,000 feet. The plant consists of generators working at 5,000 volts and transmitting power over 3½ miles of copper to transformer house. The transformers are oil-cooled and inside the transformer house there is a bank of Wentz arresters with choking coils in the mains and grounds straight down to earth plates. These have been working for many years. There is no trouble at the transformer home end.

At the generator and aluminum electrolytic arresters are installed, also water arresters. That is a wire from each of the three conductors (3 phase) is taken down to the water to the three contacts with water and kept so far apart that no current flows. None of these devices are able to protect the machines.

Perhaps some one with experience of lightning could offer suggestions, which will be received with thanks. I would also say that grounded barbed wire has been run over the poles above the line.

Aruvankadu, India. BLUE GUM.

Mosquito Larvae Killed by Foul Waters

To the Editor of the SCIENTIFIC AMERICAN:

My attention has been called to an article in the SCIENTIFIC AMERICAN of May 1, 1920, under the above title. From the context this would appear to relate to an article published by me in the Public Health Reports of August 8, 1919, and I am therefore taking the liberty of writing you about it, although I have not seen the entire article.

In the quotation from your article, sent to me, emphasis is laid on the observation that the larvæ of Anopheles mosquitoes do not thrive on foul, stagnant water. This statement, I believe, accords with the facts, but the title is apt to be misleading in giving the impression inadvertently that this may be the case with all mosquitoes, which is certainly not true. The more common mosquitoes—the so-called house mosquitoes, Culex and Aedes—flourish prolifically in foul, stagnant water and seem to thrive in proportion to the foulness of the water. This fact is very important in relation to anti-mosquito work in the northern states where Anopheles are relatively rare but the other mosquitoes are abundant. To circulate the impression in such districts that foul waters tend to inhibit mosquito breeding might do a considerable amount of damage.

In view of this possibility would it not be worth while to publish a note in the SCIENTIFIC AMERICAN calling attention to the fact that the above-noted observations apply only to Anopheles mosquitoes?

Woods Hole, Mass. CHAS. W. METZ.

Where Willow Ware Comes From

How the Tree Is Grown and Tended to Yield the Raw Materials of Furniture and Basket Factories

By George H. Dacy

FROM an artistic standpoint, the graceful, willowy willow tree which nods and courtseys with the slightest wind has long been admired and complimented as an object of rare beauty. From a utilitarian viewpoint, the willow tree and its kith and kin are just as deserving of commercial acclaim. At present willow furniture is in keen demand, especially on account of its handsome appearance, durability and light weight. Furthermore, the national demand for high-grade willow baskets still holds firm. This domestic industry, which is centered in the neighborhood of Syracuse and Rochester, is chiefly in the hands of large dealers who buy willow from the producers—there being many commercial or willow farms in that section—and peddle them among specialized basket-makers who work at home and are paid a specified sum per dozen—according to size and quality—for the baskets which they turn out.

Forestry experts, versed in basket willow culture, recommend that novitiates restrict their plantings to such varieties as the American green and patent Lemley willows. These require a minimum of cultivation, are easy to peel and ordinarily are in demand on the domestic market at good prices. Under conditions where the cost of peeling is not excessive, the purple willow which yields quality material may also be produced profitably. On account of their large size, American green willows are easier to peel, while this work can be performed at a lower cost per pound than ordinarily obtains. On the average from 6 to 10 tons per acre is a fair yield for this variety although as high as 14 to 15 tons have been harvested under especially propitious conditions. This variety of willow is in demand by furniture makers and the dealers in willow baskets. Although it outranks all other willows produced in the country, it also involves a disadvantage in that it is susceptible to insect attacks and disease. However the willow-shoot sawfly, the stool borer and the leaf rust which attack the American green willows can be controlled although the expenses of such work often are prohibitive.

All basket willows are developed from cuttings from shoots or branches. None but the best stock obtainable should be used, as the plants under such conditions often will last 14 to 15 years. Cuttings usually are purchased by the thousand from reputable growers whose stock is free of disease. Many successful growers have started with 200 to 300 plants and gradually increased as they became more experienced in the business. Cuttings, ordinarily, are set out in the spring and are made about six weeks previous in order that they may callous over at both ends as cuttings which have healed in this manner will grow most rapidly. Care should be exercised against planting any diseased or damaged cuttings as almost invariably they will fail. Selected cuttings from the tall dominant shoots are the ones to plant. Cuttings from one-year-old shoots—10 to 12 inches long—may be set out on a well-prepared, drained, sandy loam soil. If the soil is not in good condition, it is preferable to use cuttings 12 to 18 inches long which are obtained from two-year-old shoots.

A pocket knife is generally used where only a few cuttings are desired, a pruner, a corn knife or a hatchet generally are used. Using ordinary orchard pruners, two men can cut, count and tie about 5,000 American green or 7,000 purple-willow cuttings in ten hours. By strapping one handle of the pruners to a bench in which a groove is cut to hold the lower jaw of the tool, one man can perform as much work as two. The cuttings can be tied in bundles and sawed but there is always danger of damaging them so that the tips will not callous properly, but instead will rot. There

1. Bundling the willow rods in the field, after they have been cut. 2. The cutting is done by hand, with a hooked knife. 3. Preparing cuttings for the planting of new patches of willows. 4. Storing the bundles in pits where they remain until the rods are cut up. 5. Peeling basket-willow rods, a slow and expensive hand process

How the cuttings from which the crops of future years will come are prepared and tended by the modern willow-farmer

All told there are more than 200 species of willows, a basket willow variety being one which produces long, straight rods suitable for basket-weaving activities. The Federal Forest Service has distributed thousands of willow cuttings to prospective growers in all parts of the country during recent years to the extent that enough successful plantings have obtained to show that the willow can be grown profitably in all sections of the country except where limited precipitation and high elevation obstruct its development. The basket willow demands plenty of moisture and hence it can be produced only in localities where the water table is not lower than from two to six feet below the grade line. A loose, sandy loam provides the best soil conditions while the experienced grower will always select an exposure where the wind has full sweep, where conditions do not favor insect attacks and the development of fungous diseases, where weeds are not rampant and which is located so that it can be worked economically. There are also special machines on the market which the large commercial growers utilize.

Ordinarily the cuttings are set out early in the spring when the soil is moist, the weather cool and before the cuttings show much evidence of growth. A sharpened stick or iron rod from three-eighths to five-eighths of an inch in diameter and three feet long should be used to punch the hole in the soil wherein to set each cutting. Each cutting should protrude about two inches above the ground and should show one or two buds near the surface. Close spacing of the cuttings insures better yields and improved quality. Where the spacing is close, little trouble results from weeds as the plants usually choke them out. Close spacing, however, is disadvantageous in the case of the purple or Lemley varieties as after six or eight years it intensifies the tendency of these plants to die out. Hence on soils of average fertility, according to

(Continued on page 235)

From Water Tower to Lofty Dwelling

ALL sorts of improvisions in the way of dwellings have been shown and described in these columns as the result of the world-wide interest in housing. We have the converted water tower to add to our published collection—an idea, by the way, which might well be applied wherever possible.

Somewhere in New York State there is a wealthy gentleman farmer who has made over his water tower into the lofty dwelling shown in the accompanying views. Using the sturdy wooden framing as a base for subsequent operations, he covered the structure with boards and metal lath, followed by a coat of cement. The tower has been capped with an attractive roof, as shown. A stairway winds about the tower on three sides, terminating at the top on one side of a wide balcony which commands a splendid view of the surrounding country.

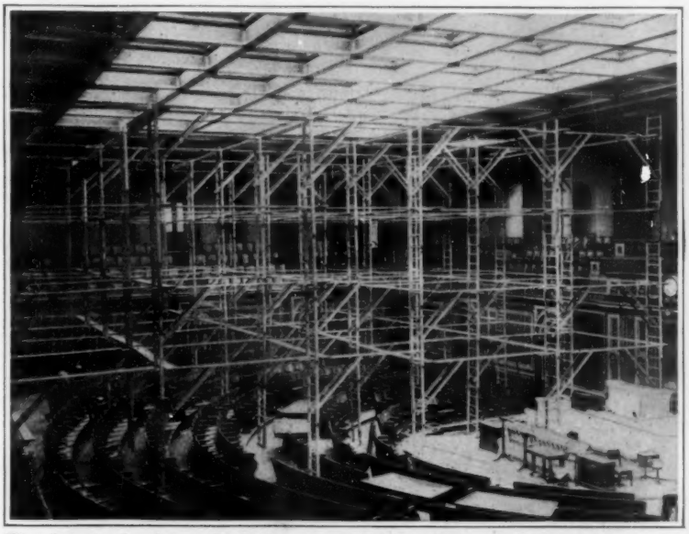
Copyright, Keystone View Co.

General view of the converted water tower and a view looking down a flight of stairs leading from the balcony

Now the water tank, which supplies water pressure to the master's house and various other buildings about the property, has been left precisely where it was before, namely, at the top of the structure. However, it is now closed in on a level with the top balcony. Below the tank is a large bedroom, and below it a dressing room. The ground floor contains the pumping engine and other equipment, much the same as it was before the conversion. There is a flight of stairs inside, connecting the second and third floors, so that one does not have to go outside in passing from one floor to the other. Electric lights, running water, steam heat and other comforts are included in this odd dwelling which affords much pleasure to its owner.—By *Alfred Langville.*

A Congressional House-Cleaning

IF cleanliness is next to godliness, as the old saw has it, then there would appear to be good authority for the poor repute in which our national legislative body is held in some quarters; for the fact is, the chamber in which the House of Representatives holds its sessions has not been cleaned save with broom and mop for the past ten years. This long period of neglect is now being brought to a termination, however, and the entire building occupied by the lower branch of Congress is having a thorough overhauling and cleaning. Our photograph shows the ladders and scaffolding erected for the use of the painters who are giving a new surface to the legislative chamber, and affords some indication that a thorough job of house-cleaning is being done.—By *Ralph Howard.*



The forest of poles and platforms erected for the use of the cleaners and painters in the House of Representatives

Traveling Derrick and Pile-Pulling Scow

MOST persons inspecting one of the mammoth ore docks at Two Harbors, Minnesota, and walking its entire length of more than one thousand feet, would have said that such a structure as this, containing more than 5,000,000 feet of timber, should certainly not be demolished. Yet that is what was done with two of the monster docks at that busy shipping point to make room for the new steel and concrete ore dock.

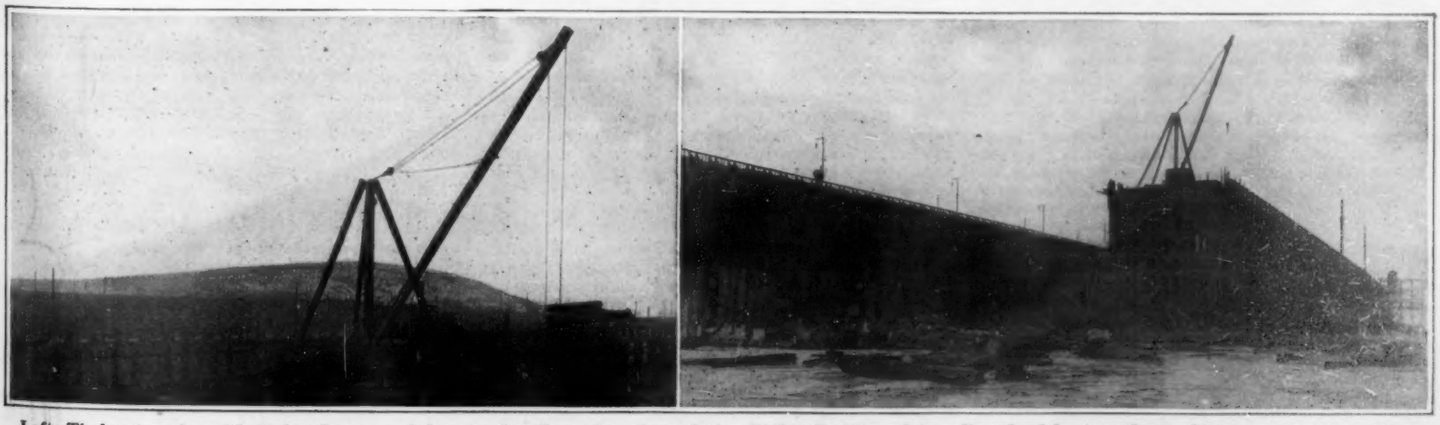
One of these docks was removed entirely; that is, the foundation piles were pulled and the foundation cribs and filling dredged out. The extent of these operations can be judged from the fact that the dock rose to a height of 56 feet, stretched out 1,054 feet, and had 170 pockets. The contractors found it necessary to use a traveling derrick with a 60-foot boom. This was carried on track rails laid on top of the dock. The structure was in such good condition that the work of wrecking it was extremely difficult, and called for many stout pulls. It was a striking example of the apparent waste in modern economy, when the old must make place for the new.

But if the wrecking of the superstructure was difficult the real tug of war came when the work was begun of pulling the long piles of white and Norway pine out of the stiff clay of the lake bottom. Some of these immense piles penetrated the clay more than twenty feet, and offered tremendous resistance. The powerful scow with its modern equipment was, however, equal to handling the work, as by means of lines leading over a heavy steel frame and two sets of five-sheave blocks it could exert a pull of 110 tons on the refractory piles and lift them from their resting places. Some idea of the extent of this undertaking can be gained from imagining that if all the piles that were yanked up out of the mud were spliced end to end to form a gigantic flag pole, then the flag would float at the rather perilous altitude of 20 miles in air.—By *George F. Paul.*

The Yawing of Ships

IN the course of experiments on the rolling of model ships in which the models were held parallel to waves by a small constraining force, Dr. K. Suyehiro noticed that for a certain range in the period of the waves the model remained always in the same position, while for the other range of the period it had a strong tendency to yaw in one direction or the other, according to a writer in a British paper. When the model was released from constraint it was found that for a certain period of the waves it yawed so as to set itself parallel to the line of the crest and for another period perpendicular to it, just as may be noticed with a boat among waves, especially if it is riding on breaking rollers on a sea shore.

Dr. Suyehiro considers that this method is caused by the action of a gyrostatic couple due to the rotational motion in two different planes at right angles—namely, pitching and rolling; and in a paper before the Institution of Naval Architects he gave a mathematical solution of the problem on this assumption. He pointed out two consequences of the phenomenon. In the first place, when a ship rides on waves nearly synchronous to her natural period of rolling she will be directed square to the waves and relieved from heavy rolling if the period of the waves is a little shorter than her natural period, but will ultimately be exposed to waves abeam and subjected to heavy rolling if the period of the waves is a little longer. In the second place, when a small boat overtakes or is overtaken by a large ship the interaction between the two will be augmented by this yawing phenomenon because the small boat, as it approaches the region of the divergent waves formed by the large ship, will be set in oscillation, and it will be turned so as to lie parallel to the line of them. Hence, if it is not properly steered, the danger of collision will be increased.



Left: Timber traveler with 60-foot boom carried on track rails on top of ore dock. Right: Position of traveling derrick at work wrecking superstructure of ore dock at Two Harbors, Minn.

The Heavens in September, 1920

How the Stars, in Actual Size, Check Up When We Put Them Against the Sun as a Standard

By Professor Henry Norris Russell, Ph.D.

SINCE first men looked intelligently upon the starry skies, they have doubtless wondered what these shining specks might readily be—at first with the vague questioning of the child in the nursery rhyme, then, as knowledge grew, with gradually greater understanding. Everyone knows now that the stars are huge luminous masses, like the sun, at very great distances; more exact information shows us that if the stars were arranged in the order of their real brightness the sun would not be very far from the middle of the sequence—at least, of the portion known to us. The brightest star—not to our eyes, but in reality—of which we know is Rigel, in Orion, which is some twelve thousand times brighter than the sun; the faintest so far known is the feeble distant attendant of Alpha Centauri, which is a little less than one ten-thousandth as bright as the sun. Between these widely separated extremes we know of hundreds—nay, thousands—of stars of all degrees of luminosity.

But what of the real sizes of these remote bodies? If a star is brighter than the sun, is it also bigger? It may well so happen; but it is not necessarily the case, for if a star is hotter than the sun, and gives out more light per square mile of surface, it may exceed the sun in brightness even though it be somewhat smaller in diameter. Conversely, a star may be fainter than the sun and yet larger in size. The observed sequence of stars, arranged according to the amount of light which they give out, depends therefore in a rather complex fashion upon the interaction of these two factors. Can we hope to separate them, and so come to some knowledge of the true diameters of the stars at large?

In the rare cases of eclipsing double stars (variable stars of the so-called Algol type) we can obtain definite data regarding the relative size and brightness of the two stars of a pair; and in a very few instances spectroscopic data enable us to translate these into actual diameters in miles. In these instances the stars usually turn out to be bigger than the sun, but not very much bigger—five or six times the sun's diameter being exceptionally large.

But these few cases are hardly enough to trust as a fair sample of the stars in general, with their great variety of brightness and color. To go further, we must try to get some way of estimating how much light a star gives off from each square mile of surface—its surface-brightness.

Optical Pyrometry Upon the Stars

It is a commonplace of experience that, as any solid body is heated hotter and hotter, it begins to shine, and shines more and more intensely, while at the same time the color of its light, at first dull red, becomes yellower, and at last white. The theory of radiation, which is now well developed, enables us to give numerical exactness to these qualitative impressions, and to estimate the temperature of any hot body from the color of the light which it gives off. Indeed, this "color-match" method of determining temperature is of sufficient accuracy to be of practical usefulness in some industries which employ highly heated furnaces. By an extension of the same principle, we may estimate the temperature, and also the surface-brightness, of a star, if only we know its color. To be sure, the stars are not solid bodies, but masses of gas; yet there is good reason to believe that this does not seriously vitiate the application of the theory. Several lines of attack are open. The simplest is afforded by the eclipsing variables already mentioned. Here in many cases we find systems composed of a large faint star and a smaller, but brighter, one which is eclipsed behind it. In these systems the large faint star is always found to be red, and the small bright one white. And, in general, the greater the difference in color, the greater also is that in surface-brightness.

Other methods of investigation lead to similar conclusions, and, though the data are still scanty, all are in tolerable agreement as to the degree in which surface-brightness varies with difference in the color of the star—or, for that matter, with the class of the star's spectrum, which is very intimately associated with the color of its light.

From the available data, it seems probable that the whitest and hottest stars, like those in the belt of Orion, give out about twenty times as much light per square mile as the sun does. Stars like Sirius, a step lower in temperature and color, may be of seven or eight times the sun's surface-brightness; and yellowish stars, like Procyon, twice as bright as the sun. Those resembling the sun in color and spectrum may be assumed to be similar also in surface-brightness; but orange stars, like Arcturus, are probably of about one-sixth the surface-brightness of the sun, while red stars like Antares may fall as low as one-thirtieth, or even lower.

Big Stars—and Bigger Ones

Fortified with these estimates, we may proceed to figure out how big some of the familiar stars are. Let us begin with Scorpio—so well seen in the summer sky. The principal stars of this constellation are remote and very bright. All but Antares are also very white, and doubtless very hot. The brightest of these is Lambda Scorpio, at the end of the tail, which gives out about 1,500 times as much light as the sun. Being so white, we may estimate its surface-brightness as 15 to 20 times the sun's—which makes its area from 75 to 100 times that of the sun, and its diameter nine or ten times the sun's—taking round numbers. The other conspicuous stars of the constellation are a little fainter, and probably somewhat smaller; but all of them are probably several million miles in diameter. Antares, however, is an exception. It is enormously bright, giving out about 3,000 times the sun's light, and is also very red. Estimating its surface-brightness, correspondingly, as one-thirtieth the sun's, we reach the enormous area of 90,000 times the sun's, and a diameter 300 times that of the sun, or a quarter of a billion miles. Extraordinary as this result may seem—a star so huge that the whole orbit of the earth could be put inside it—it is hard to see what modifying factors could greatly alter the estimate; and of course such an object is very small indeed in comparison with the nebulæ, which are hundreds or thousands of times greater in diameter.

Of the other conspicuous summer stars, Arcturus is probably the biggest. It has a little over 120 times the sun's luminosity, probably some seven times its area, and roughly 25 times its diameter. Vega, which is a little nearer than Arcturus, and gives out about five-sixths as much light, is a white star, and its diameter works out about four times that of the sun. Altair is a relatively near neighbor of ours, and is actually only some eight times as bright as the sun, and probably three times as bright per square mile—which makes its diameter half as great again as the sun's. Procyon, which is a little fainter and a little yellower and cooler, is probably very much the same size as Altair. Sirius, some 25 times as bright as the sun, is white, and its probable diameter is twice the sun's. Rigel, which gives evidence of being hotter than Sirius, has perhaps ten times the sun's surface brightness, which would make its diameter 35 times that of the sun, but only about one-tenth that of Antares.

So the story goes. Of the stars which are conspicuous to the naked eye, some, which owe their apparent brightness to their proximity, are but little larger than the sun in actual diameter. Others, which are remote and of great real brightness, run much larger—especially the giant red stars; but there are probably very few that exceed the dimensions computed above for Antares.

To find stars smaller than the sun we must look among the faint members. Take for example the well-known double, 61 Cygni. The stars of this pair are about 1/20 and 1/40 as bright as the sun. They are also orange-red in color, and their surface-brightness may be estimated as 1/20 that of the sun, which makes the diameter of the brighter component about equal to the sun's, and that of the fainter three-quarters as great. Passing to still fainter objects, we may take Barnard's star—the second nearest in the heavens—which gives out 1/2,500 of the sun's light. This is an extremely red star, and its surface-brightness, on the basis of our previous estimates, would be perhaps 1/50 of the sun's. This would make its diameter about one-seventh of the sun's, or some 120,000 miles. There is some reason to believe that this is too small an estimate, and that these very faint stars give out even less light per square mile than we have suggested. None of these tiny stars, however, can be seen without a telescope, and hence our conclusion stands, that the stars visible without instrumental aid are for the most part of the size of the sun or larger, but that the large majority of them are less than ten times the diameter of the sun, while a very few run up to the size of the earth's orbit.

At 11 o'clock: Sept. 6.
At 10½ o'clock: Sept. 14.
At 10 o'clock: Sept. 21.
At 9 o'clock: Oct. 7.
At 8½ o'clock: Oct. 15
At 8 o'clock: Oct. 22.
At 9¼ o'clock: Sept. 30.

The hours given are in Standard Time. When local summer time is in effect, they must be made one hour later: 12 o'clock on September 6, etc.

NIGHT SKY: SEPTEMBER AND OCTOBER

The Heavens

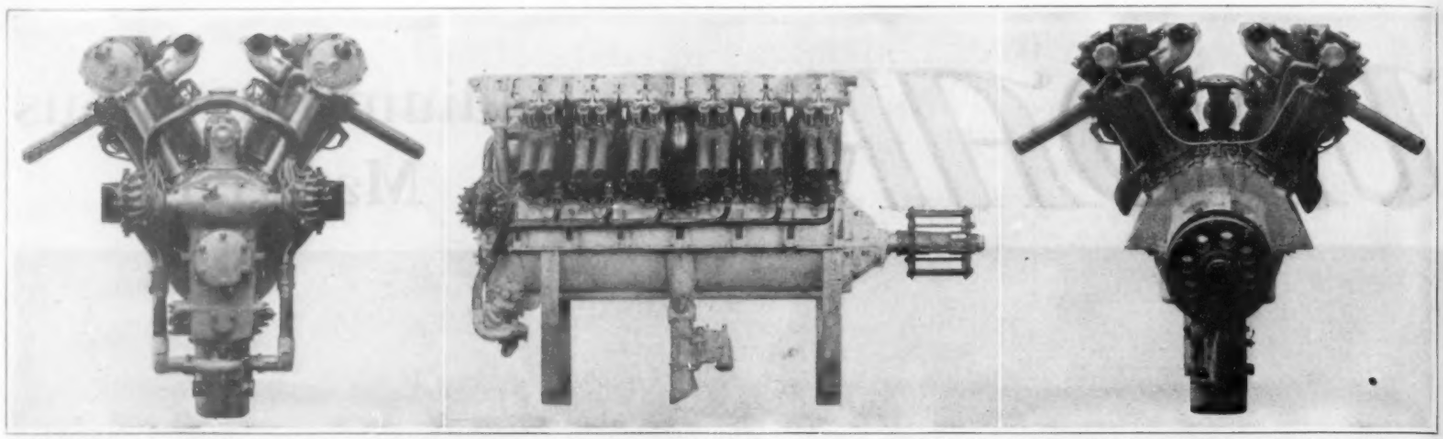
Our map shows the appearance of the sky in the later part of the evening, when the summer constellations are nearly gone and those of winter are beginning to rise. Sagittarius, Ophiuchus and Bootes are setting. Hercules and Aquila are still in sight with Lyra above and between them and Cygnus still higher. Fomalhaut is the only conspicuous star in the south, and Pegasus and Cetus are the principal constellations in the southeast. Andromeda, Perseus and Aries are well up in the east and northeast, while Taurus and Auriga are rising. The Great Bear is low in the north; Draco and Ursa Minor are above, and Cassiopeia and Cepheus still higher.

The Planets

Mercury is in conjunction with the sun on the 8th, and becomes an evening star; but he is practically invisible until the end of the month, when he sets three-quarters of an hour later than the sun, and can be seen in the twilight, though not so well as next month.

Venus is also an evening star, and is gradually becoming more conspicuous. At the end of the month she sets half an hour later than Mercury, and should

(Continued on page 235)



Left: Rear view of engine, showing the accessibility of the water pump at the rear of and below the crank case. *Center:* Right side of engine. Note the single duplex carburetor, set below and outside the crank case. This constitutes the outstanding feature of the design. This not only makes the engine fire proof so far as the carburetor is concerned, but solves the problems of synchronizing throttle and altitude control and saves weight. *Right:* Front view of engine. The included angle of the cylinder groups is 60 degrees. The individual type of cylinders, which provide the best water circulation and thus keep the cylinders cool and avoid valve trouble, are used

Three views of the engine recently designed by Col. Jesse G. Vincent, which incorporates several novel features and gives remarkable results for its weight

A Forward Step in American Airplane Engines

By Col. Jesse G. Vincent

IT needs but a superficial study of present-day airplane design to convince even the uninitiated that the airplane of the future will be larger, have greater load capacity and more radius than the planes we have today. In order to accomplish this larger engines will be required or else the power plant must be divided among many small units.

It is an engineering axiom that a few large engines will generate a certain number of horse-power more efficiently than a greater number of small engines. There is also a greater degree of reliability to be secured with the larger engine, since it is possible for the same weight per horse-power to design parts with a greater factor of safety and small flaws and imperfections are less liable to interfere seriously with the strength of the larger parts.

It is evident then, that the evolution of the airplane will closely follow the development of the engine. It was at first thought that the air propeller placed a definite limitation on the possible size of an airplane engine. This limitation undoubtedly still exists, but engine design has not yet been definitely affected by this factor.

Good engineering practice requires that a design be based on certain practical and theoretical conclusions and it therefore follows that a new engine design must be based on the experience gained with engines which are comparable in size and general design with the proposed engine. With the great amount of experience gained with the Liberty motor at my disposal and also after study of the performances of all the best foreign engines, I undertook the design of this engine having about 25 per cent greater displacement than the Liberty with perfect confidence that the engine would prove fully as efficient and reliable as the Liberty and in addition would have features which experience had demonstrated were desirable.

The carburetor arrangement called for the principal departure from previous designs, and tests which have been made on the ground and in the air have demonstrated the desirability of this design from every standpoint. A single duplex carburetor is bolted to the underside of the lower half of the crankcase and the intake passages are cast integral with the upper and lower halves of the crankcase. Suitable manifold extensions serve to connect the cylinders and passages.

This arrangement presents many advantages. Firstly, it locates the carburetor in a low position in the plane which permits of a gravity fuel system, the simplest and most positive method of insuring a constant supply of fuel to the carburetor, eliminating the complication and added weight of fuel pumps, piping, valves, etc.

Secondly, the carburetor air-intake is allowed to project through the lower cowling of the fuselage and in this manner all fire hazard due to a back-fire is removed, it being noted that all gasoline vents discharge into the air-intake so that gasoline leaks within the cowling are absolutely prevented. This makes the airplane entirely fireproof for all civil uses.

The third advantage in connection with the use of a single carbureter is that a single adjustment suffices for the whole engine. In previous large engines it had been the practice to employ as many as four separate carburetors and it was practically impossible to make the idling, running and altitude adjustments the same for all cylinders.

It is interesting to note that this carburetor is probably one of the largest built and is capable of handling sixty gallons of gasoline every hour!

(*Continued on page 236*)

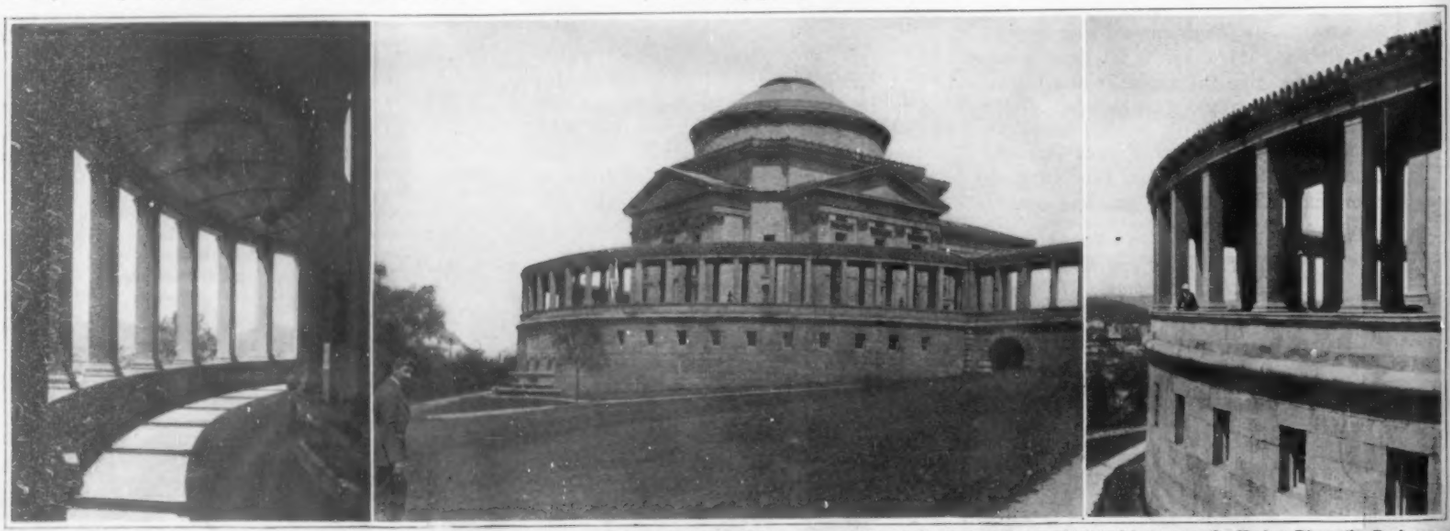
This Year's Nominations for the Hall of Fame

THE ballot for the fifth quinquennial election of the Hall of Fame has already been to the board of 102 electors and votes for the various candidates on the ballot will be received by the Senate of New York University until October 15. Announcement will be made on November 1 of the names that have been chosen by the electors for inscription in the Hall. The names of 68 men and 4 women who have not been candidates in previous Hall of Fame elections appear on this year's ballot, as well as several score of other names that have been voted upon in former elections but which failed to receive a sufficient number of votes to elect.

There are 11 inventors and 10 scientists whose names will be voted upon this year. Of the 11 inventors 5 are new nominations: Ottmar Mergenthaler, inventor of the linotype machine; William Austin Burt, inventor of the solar compass, the equatorial sextant compass and a very early typewriter; Stockton Barton, inventor of sewing machine devices; Robert L. Stevens, inventor of engineering devices; and Walter Hunt, nominated as the real inventor of the sewing machine. The 6 inventors whose names were acted upon in previous elections but who did not receive the number of votes necessary to elect but obtained a sufficient number to place them upon the ballot again this year are Charles Goodyear, Richard Marsh Hoe, Cyrus Hall McCormick, John Ericsson, Robert McCormick, and George Henry Corliss.

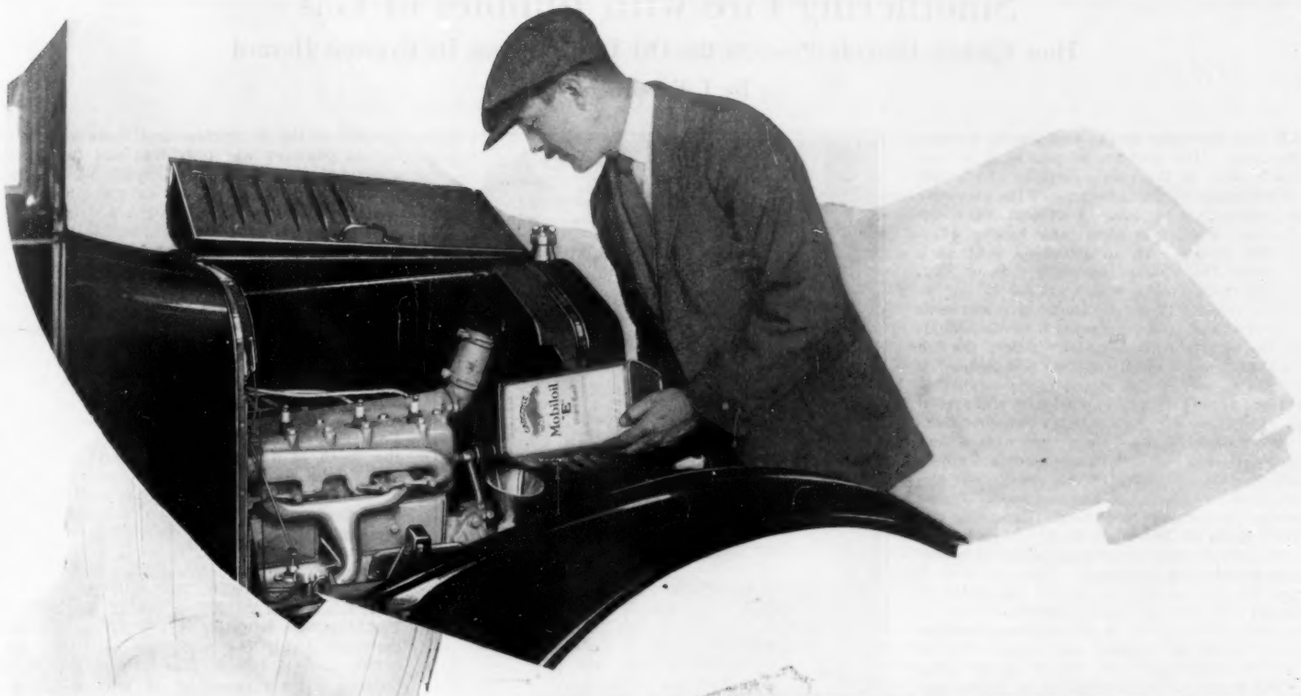
Walter Hunt, nominated by his grandson as the "real inventor of the sewing machine," is perhaps the most interesting of the new nominations for the reason that five years ago Elias Howe was elected to the Hall of Fame as the inventor of the sewing machine and Howe's name has already been inscribed on a

(*Continued on page 236*)



Left: Interior view of the Hall of Fame. *Center:* The Hall as seen from the park at the rear. *Right:* The corridor of the Hall of Fame, which looks out over the Harlem River, the Dyckman Valley, and even a small section of the Palisades beyond

The Hall of Fame on University Heights, New York City



FORD ECONOMY

How Gargoyle Mobiloil "E" reduces friction-heat, carbon and wear

WHEN a Ford owner turns to Gargoyle Mobiloil "E" he nearly always gets one of the big surprises of his motoring experience.

He finds that engine overheating—excess carbon forming—spark plugs fouling—excessive gasoline and oil consumption—excessive friction and wear, are all unnecessary.

He finds that the Ford high-speed conditions *need* not invite frequent overheating.

He finds that he never before really knew how little carbon need accumulate in a Ford engine.

He finds that previous fuel and oil consumption were unnecessarily high.

He finds that frequent repairs and replacements of worn parts are no longer necessary.

He secures new power, especially noticeable on the hills.

The ability of Gargoyle Mobiloil "E" to reach all moving parts is due to its scientifically correct *body*. Its ability to absorb and radiate heat and give full protection to the frictional surfaces is due both to its high *quality* and to its correct *body* and *character*.

This means full protection—particularly vital to a Ford when low gear is in frequent use.

Combustion heat plus excessive friction heat causes overheating of the engine, boiling and evaporation of water from the radiator and unnecessary wear of the moving parts. Water is cheap. Repairs and replacements are not. Ford economy—great under all conditions—is made even greater through the year around use of Gargoyle Mobiloil "E".

This has been demonstrated repeatedly in all parts of the world. It is being proved daily all over the United States—*perhaps today by your next-door neighbor!*

With your oil reservoir emptied and refilled with Gargoyle Mobiloil "E", your engine will give you quick and ample evidence.

Write today to our nearest branch for a copy of our booklet, "Your Ford—Four Economies in its Operation." It gives the vital facts in regard to Ford lubrication.

GARGOYLE

Mobiloils

A grade for each type of motor

Domestic Branches:

New York, Boston, Philadelphia, Pittsburgh, Detroit, Chicago, Minneapolis, Indianapolis, Kansas City, Kan., Des Moines

VACUUM OIL COMPANY *Specialists in the manufacture of high-grade lubricants for every class of machinery. Obtainable everywhere in the world.* **NEW YORK, U.S.A.**

Smothering Fire with Bubbles of Gas

How Carbon Dioxide Protects the Oil Tank Against Its Greatest Hazard

By J. F. Springer

STORAGE is a necessity in the business of producing petroleum. The problem of providing it is a gigantic one because of the vast quantities of oil that must be put into reservoirs and because of the excessive liability to destruction by fire. A typical oil reservoir will be, say, a circular steel tank having a capacity of 50,000 gallons. In an active oil field, such tanks may cover the visible landscape. Some day, suddenly, a lightning stroke will start oil in one of the tanks to burning. Under ordinary circumstances all the oil of this tank will be consumed in the conflagration and the owners will be content if only the fire does not spread. Only indifferent success seems to have attended the use of water and other liquids in respect to the extinction of a flame once started on the surface of a large body of oil. Petroleum is exceedingly combustible, being made up almost entirely of hydrogen and carbon in compounds tremendously eager to split up and give the constituent elements to any free oxygen in the neighborhood. Water acts by smothering combustion through preventing the access of the oxygen in the atmosphere. Other liquids either act similarly or produce gaseous material which performs the smothering operation. The problem of extinguishing the fire consists in getting the liquid or gaseous blanket all over the flaming surface.

But a new thought occurred to an American inventor some years ago when the century was young. This is the *foam* or the *suds* idea. Mr. Elmer Gates noted that if a given weight of fire-extinguishing liquid was first converted into a lather, the effect upon the flame is multiplied over what it would have been if used in the ordinary way. The greatly increased bulk of the liquid when converted into froth enabled it to screen the air, therefore the oxygen, from the surface on to which the fire-extinguishing material might be thrown. Over and above the foregoing idea was another entertained by the same inventor. He saw that if the bubbles of froth should themselves contain instead of air some other gas which was a non-supporter of combustion, the effectiveness of the suds would be enhanced. As the bubbles burst, their gaseous contents mingle with the air in the immediate vicinity and thus render it a less active supporter of combustion. Such gases as nitrogen, ammonia, carbon dioxide, are suited for the filling of bubbles. A gas of this kind may be very quickly mixed with the liquid from which the suds is made and a very large amount of the foam brought into existence. He considered that the bubble-like lather should contain inorganic salts of such character that upon heating they would decompose and evolve incombustible gases.

Here, apparently, we have the origin of the process which has subsequently been developed and utilized for the extinction of petroleum conflagrations and great and small fires of a more ordinary character. Mr. Gates' patent was issued January 12, 1904. He specifies for a suitable mixture a thick solution of ammonium soap. This may contain, for example, dissolved borax or ammonium sulfate. This solution, when ejected from a suitable nozzle, by pressure of a non-combustible gas, constituted his foam jet for the extinction of fires—the ancestor of the present successful means of using bubbles.

An early experiment in the use of foam extinguishers

Germany seems to have been the scene of the next developments. The early method took no account of the difficulty of forcing foam through conduits. Besides, it rather assumed that the mixture was already prepared. Consequently, with provision for maintaining separately the liquids to be mixed and effecting their mixture only at the time of use and close to the point of use, important advances were made. The older method was adapted to small hand apparatus. In the case of a petroleum tank, where large masses of foam were needed quickly on the surface of the oil, difficulties were encountered. These related particularly to the fact that with the older method the foam was forced through long conduits. During its passage, it was more or less subject to reconversion into liquid. Besides, the gas pressure behind it was somewhat liable to be impaired when the foam reached the tank. The improvements, due apparently to Herr Ernst Bartels, consisted principally in forcing two liquids through separate conduits to the immediate vicinity of the oil surface and there mixing them. A mixing chamber was provided; and from it the foam generated by the chemical reactions set up by the conjunction of the two liquids was ejected on to the oil. The Bartels English Patent was issued October 5, 1911.

In the meantime a United States patent was issued to certain officers of the Standard Oil Company of California for a system using two liquids of such composition that, when brought together, the gas carbon dioxide would be generated. This patent was issued February 21, 1911. About this time the United States Navy became concerned over the question of extinguishing fires on board oil-burning ships. A special board after deliberation recommended the use of the foam system. At Bayonne, N. J., on the border of New York Harbor, a tank 16 x 4 feet in area was filled to the depth of 5 inches with naphtha and set on fire. The flames rose to a height of twenty feet. But an application of a fire-extinguishing suds put the fire out in a few minutes. The liquids employed upon this occasion were probably formed more or less in accordance with the following recipes, the figures referring to parts by weight. Liquid No. 1: Glue, 1; glucose, ½; sodium bicarbonate, 7½; salicylic acid, ¼; water, 100. Liquid No. 2: Aluminum sulfate, 10; water, 100. The aluminum sulfate [$Al_2(SO_4)_3$] and the sodium bicarbonate ($NaHCO_3$) react upon each other and evolve carbon dioxide (CO_2). The foam is readily produced because of the presence of the glue and glucose. The salicylic acid acts as a preservative of the glucose. The glucose has an additional duty, that of stabilizer. In liquid No. 2 sulfuric acid was tried as stabilizer, but its corrosive effect on the container was objectionable. The volume of foam is eight times that of the combined liquids.

It is, naturally, very necessary that a good suds be made. Of the substances used for this purpose, an extract of licorice root is apparently one of the best. It was mentioned in this connection as far back as 1906 in the provisional application of Prof. A. G. Laurent of St. Petersburg, for an English patent. The most modern development of the foam system also employs it. Thus, the following percentages (again by weight) represent a pair of mixtures which are up to date, the "suds material" being a secondary extract of licorice root. Solution No. 1: Aluminum sulfate, 11; water 89. Solution No. 2: Suds material, 3; sodium bicarbonate, 8; water, 89. It will be noted that we have here an acid and an alkaline solution. The suds material is here put with the latter. Upon being mixed, the volume is increased to about ten times that of the original total. The bubbles will be fine and tenacious and will be filled with carbon dioxide. Moreover, the whole will flow well. The chemical reaction between the aluminum sulfate and the sodium bicarbonate is as follows:

$$Al_2(SO_4)_3 + 6\,NaHCO_3 = 3Na_2SO_4 + Al_2(OH)_6 + 6CO_2$$

When the bubble mass has done its work, the carbon

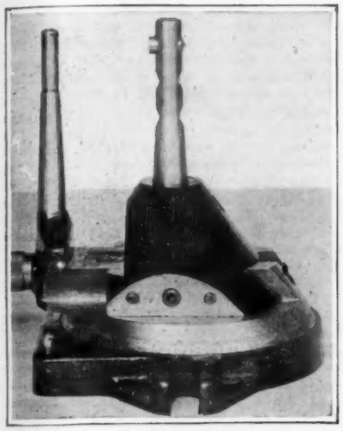
(Continued on page 237)

Discharging foam on to burning oil from a stationary device

A bad fire at Philadelphia in which several firemen were killed

Inventions New and Interesting

A Department Devoted to Pioneer Work in the Arts



This device dresses grinding wheels accurately and quickly

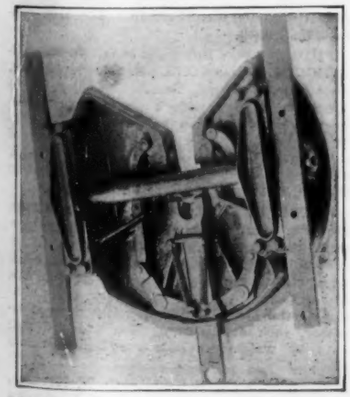
An Accurate Grinding-Wheel Dresser

A NEW tool for dressing abrasive wheels with radial or angular faces has been introduced by a Detroit manufacturer. This tool will dress a 12-inch wheel to a radius of from 0 to 1¼ inch, either convex or concave, and to any angle desired. The tool post has three splines so the diamond may be set at right angles with the travel of the side for dressing angles. It also has 2-inch center height adjustment. When the distance from the back of the measuring post to the pivot center is known to be 3 inches then it is only a matter of addition or subtraction to obtain the required convex or concave curve.

An Automatic Trailer Connection Device

A DEVICE for automatically coupling a trailer with a motor truck is a new product of a Massachusetts manufacturer. By using this device it is not necessary to use jacks to make the connection. As the tractor vehicle backs into the trailer a cam formed by the rear end of the device sliding down raises the trailer and continued backing couples it automatically.

When disconnecting the wheels of the trailer are blocked and a horse is placed under it. As a lever near the driver's seat is pulled the truck is disengaged from the coupling and enabled to move away from the trailer.



This device for coupling trailer and truck does away with jacks

Is the Phonograph Fast or Slow?

SINCE the pitch of any photograph changes with the speed of operation, it is obvious that proper results can be had only when the correct speed obtains. Most phonographs are equipped with devices of one form or another to indicate the speed of the turntable, but in many instances these devices are not accurate. It is necessary to have recourse to some other method, such as counting the turns per minute, in order to check up the speed.

Among recent phonograph inventions is a speed indicator, which is shown in the accompanying illustration. This device consists of a small base which fits over the pin on the phonograph turntable, a standard, and a pivoted and weighted arm which serves as the indicator. The device is placed on a phonograph record which is to be played. As the turntable reaches its set speed,

The weighted and pivoted arm indicates the speed of the phonograph

a little weight at the end of the pivoted arm is thrown outward by the centrifugal force. The extent of this movement is indicated by the other end of the arm, which passes over a scale on the standard. The scale is of such simplicity that it can be readily read while the device is whirling around.

Speeding Up the Rowboat with Paddlewheels

EVERY so often someone comes forth with a scheme for placing paddlewheels on a rowboat. This time it is an Englishman, who has been making small boats fitted with paddlewheels, as shown in the accompanying illustration. The paddlewheels are turned by means of cranks, and it is said that this method of propulsion has met with much favor at English summer resorts.

New Cold Process for Vulcanizing Rubber

IT is reported that a very important discovery of a new process of vulcanizing rubber has been made by Professor Peachey of the Manchester (England) College of Technology. Laboratory experiments prove that the process will have far-reaching effects on the rubber-manufacturing industry. The importance of the discovery is in the fact that it is a method of cold vulcanizing. It makes use of two gases, sulfretted hydrogen and sulfur dioxide, which react on each other to produce water and free sulfur. The professor has found that when crude rubber, either in a solid form or in solution, is treated with these two gases the sulfur produced by their interaction vulcanizes the rubber. If the rubber be mixed with a waste material such as sawdust or leather scraps or paper, and the mixture is vulcanized, the resultant materials will serve a variety of useful purposes.

A New Bar Straigtening Machine

A MACHINE for straightening bar stock up to 2 inches in diameter has lately been introduced by an Illinois manufacturer. V-blocks support the work while it is being acted upon by the screw. When the screw is elevated two sets of spring-actuated rolls lift the bars above the Vs so that it may be easily rotated.

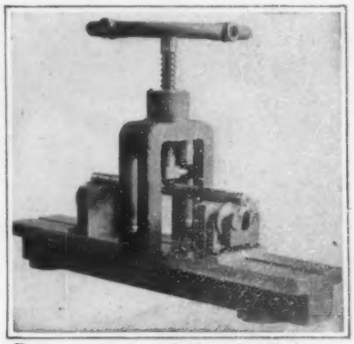
A Washing Block for the One-Armed Man

THERE are some things that a one-armed man can do for himself with no trouble and with no special apparatus. There are other things, doubtless, that he can't do for himself, with all the trouble in the world and all the ingenious devices that might be brought to bear on the problem. But between the two extremes there are a great many things that he can do for himself with the aid of a little patience and a little ingenuity; and one of these concerns the washing of his lone hand and arm. The cleansing of other parts of his anatomy presents no special problem; but how to wash a hand effectively with no other hand to conduct the operation is not immediately clear. A German inventor has made it clear, however, with the little apparatus which we illustrate.

The curved inner surface of the wooden block which constitutes the

England is having much fun these days with paddlewheel rowboats

foundation of the device is cut approximately to the shape and size of the human arm. It is lined at different points with several fabrics of different degrees of harshness and softness, and with a coarse brush so that it is ready for any kind of a scrubbing job from axle-grease to the mere dead skin and excretions of the night. On its short upright it carries a finer brush for the knuckles; on its outer face it presents a bit of abrasive cloth for the filing of the finger nails; and at the top of the long arm is found a nail-cleaner which, in distinction from its prototype in ordinary use, is held stationary while the nail of the user is drawn about it. Finally, it holds a towel, securely fastened at both ends. With this outfit the one-armed man is able to complete his toilet so far as it refers to his hand and arm, and to maintain himself on an equal basis of cleanliness with any of his more fortunate two-armed brethren.



Bars up to two inches in diameter can be straightened with this device

Latest Patent Decisions

Commercial Success as a Measure of Utility:—This is a suit in equity by the Whitlock Coil Pipe Co. against the Mayo Radiator Co. The decree herein is for the defendant. The pleadings raised the issue of non-infringement and invalidity. The patent refers to the invention as an apparatus for effecting the cooling of one fluid by the application of another and cooler fluid, such as the cooling of air by water, or of water by air—the condensation of steam by either air or water. In the patent, the patentee says: "That portion of the apparatus to which my invention relates, in common with other and similar apparatus, comprises a series of air tubes surrounded with water passages forming part of a water circulating system, by which the water which has become heated by its contact with the cylinder will lose its heat, and by its contact with the air tubes, through which, in order to increase the efficiency of the apparatus, the currents of air are caused to move." The plaintiff sues on all the claims of the patent. The court holds that there has never been made, with any commercial success, a structure which conforms to the specifications and claims in suit. It would be unfair to claim that the defendant's device infringes the plaintiff's device when the latter has added no substantial value to the art. To sustain the claim of the infringement would be to interpret the language of the claim as broad enough to

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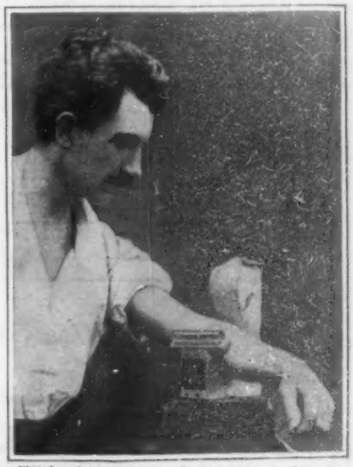


With this device the one-armed man can wash, and wash clean

Recently Patented Inventions

Brief Descriptions of Recently Patented Mechanical and Electrical Devices, Tools, Farming Implements, Etc.

Pertaining to Aeronautics

AERIAL BOMB.—G. E. COOK, 45 Tehama St., Brooklyn, N. Y. This bomb is particularly designed to be dropped from an airplane, dirigible or other aircraft, and to explode on striking an object. It consists of a body provided with a large number of explosive shells containing shrapnel or the like, which shells explode before reaching the ground, thus rendering the bomb exceedingly destructive.

Pertaining to Apparel

WAISTBAND.—BERTHA CLARK, 342 50th St., Brooklyn, N. Y. This improved waistband for skirts, petticoats and similar garments is arranged to enable a dressmaker to readily lengthen or shorten the waistband to suit the waist size of the garment on which it is to be used. Another object is to permit of stiffening the band after attachment to prevent the waistband from crumpling when the garment is used.

FASTENER.—J. P. BURKE, Box 125, Struthers, Ohio. The present invention comprises a fastener of ball and socket type especially adapted for use on garments. The device is made up in whole, or for its major portion, of wire. It possesses the advantage that it can be made very small and inconspicuous and it may be rendered practically invisible when colored to suit the fabric to which it is applied.

SHIRT.—H. H. HERST, Ocean View, Va. Mr. Herst's invention relates more particularly to men's outer shirts, and its object is to provide a novel construction in connection with the front portion of the shirt to conceal and hold the flowing ends of four-in-hand ties. The upper and inner portions of the front of the shirt are cut away to form a V-shaped outlet, and special provision is made to insure the retention of the shape of this outlet in laundering.

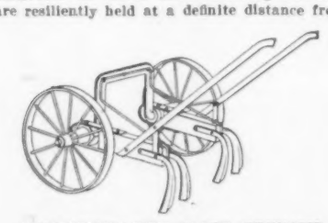
Electrical Devices

THERMAL CIRCUIT CLOSER. — C. E. WIREN, 1637 61st St., Brooklyn, N. Y. An object of the invention is to design a bearing and journal indicating and protecting device capable of warning against continuing the operation of a bearing of machinery when said bearing is nearing the danger point of over-heating and approaching the point of destruction due to lack of lubrication. The invention provides means for closing an electrical circuit adapted to ring a bell or light an electric bulb light to warn against continued operation.

POWER GENERATING SYSTEM.—G. YANACOPOULOS, 541 E. 169th St., New York, N. Y. This invention relates to a power generating system and has for an object the provision of a construction wherein wind is utilized for compressing air to act as motive power for producing electrical current or for other purposes. A further object is the provision of a system whereby electrical energy may be produced and stored, the power necessary for the production being secured through a system of related machines for converting the power of the wind into a driving member for the generating dynamo.

Of Interest to Farmers

CULTIVATOR.—H. C. SMITH, Clintonville, Conn. This invention relates to cultivators and has for an object the provision of a cultivator in which the cultivating members are resiliently held at a definite distance from



A PERSPECTIVE VIEW OF THE CULTIVATOR

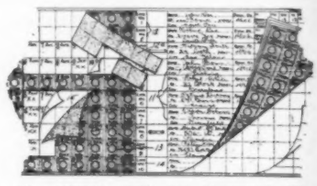
the row of vegetables being cultivated, this distance being easily varied, the resilient means consisting of a spring mounted on an arched axle having integral arms extending downwardly and rearwardly.

CULTIVATOR.—R. L. GUTHRIE, R. 3, Box 409, Santa Rosa, Cal. More particularly this invention relates to cultivators of the wheeled type, an object being to provide a cultivator which will be capable of a wide range of adjustment and which is relatively light so as to be easily moved over the ground. A further object is to provide a cultivator which may be utilized either as a pulling or pushing device, and which permits the plow standards and adjacent parts to be swung up out of the way and suspended on the handle.

FARM GATE.—T. HOUSTON, 202 Citizens Bank Bldg., Kokomo, Ind. The purpose of this invention is to provide a simple and inexpensive farm gate having means for holding one end of the gate in suspension, such means being adjustable to vary the height of the gate so as to permit the ready opening thereof under adverse conditions, such as when snow accumulates beneath the gate.

Of General Interest

ACCOUNT BOOK.—A. HEISTERKAMP, 517 Garden St., Hoboken, N. J. This account book is particularly adapted for the use of societies and other organizations to enable inexperienced persons to keep an accurate record of all transactions. On one page are entered the names and addresses of members

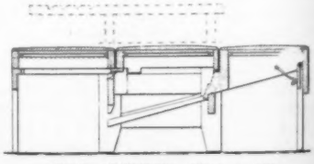


AN ACCOUNT BOOK FOR SOCIETIES AND ORGANIZATIONS

and on the opposite page, similarly ruled, are numbered spaces divided by perforations into series of stamps. Below this page is a wax page representing periods when dues to the organization are to be paid. As the dues are paid, the stamps are removed and pasted in a pass-book of the member.

IRONING SUPPORT.—S. E. DURANT, 176 W. 137th St., New York, N. Y. The object of the invention is to provide an ironing support more especially designed for ironing or pressing open-ended neckties, scarfs and similar neckwear, and arranged to permit convenient insertion of the support into either end of the neckwear to hold the same in propor position for an effective ironing or pressing.

CHAIR BED.—W. E. ESLHENBRENNER, 440 E. 143rd St., New York, N. Y. The invention provides an arm chair of the type commonly known as the Morris chair. The adjustable back which may be lowered into alinement with the chair



CHAIR CONVERTED INTO A BED

seat has a section under the seat which may be drawn out into alinement with the seat thus converting the chair into a bed of comfortable length.

PIGMENT-POWDER FOR MAKING SMEAR-PROOF IMPRESSIONS.—S. M. MCMURRAY, 54 Arcade, Nashville, Tenn. The object of the invention is to provide a pigment powder to be used in connection with an ink, such as printers' ink, or stamp pad ink, to bring out or intensify the impression made with the ink and also to render the impression resistant to the action of gasoline.

CUTTING BLOCK.—C. F. CONNOR, 23 Florence St., Marlboro, Mass. The invention pertains more particularly to a method of securing the several sections of a cutting block together. The prime object is to provide side and end bars by which the several parts making up the block may be securely clamped together, each of the bars being provided with nuts by which the bars are tightened into place.

FISH AND CRAB TRAP.—C. W. MUELLER, 1094 Summit Ave., Jersey City, N. J. An object of the invention is to provide a collapsible form of fish and crab trap which is convenient in transportation from place to

place. A particular feature relates to a folding frame on which the netting is applied. This permits the owner of the trap to adequately fold it up until it assumes a compact single one-piece package. The device has few parts, is strong and durable.

STATIONERY APPLIANCE.—E. P. BECKWITH, Garrison, N. Y. The object of this invention is to construct an appliance which is more particularly intended to be used in connection with stationery and by means of which it will be possible to almost entirely eradicate creases from papers and particularly from blue prints without in the slightest affecting the same.

HANDLE FOR HANDBAGS.—N. SLOANE, 228 Roebling St., Brooklyn, N. Y. The general object of the invention is to provide a handle combining a rigid arm-receiving ring with a flexible element adapted to connect the same in a novel manner with the bag frame so that the two jointly form a handle possessing advantages in the secure carrying and handling of the bag.

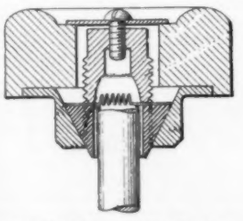
CAN SPOUT.—H. H. SHAW, Cambria, Cal. The invention relates to a device adapted to be inserted in a can, such as an evaporated milk can, by driving into the head thereof to thereby constitute a spout for the pouring of the contents from the can as desired. The device may be driven into the can by pressure or a blow of the hand, thereby obviating the necessity of any tool to deliver the driving blow against the spout.

DRIP WATER SAFE.—J. J. HICKEY, 2138 Lexington Ave., New York, N. Y. The invention has particular reference to plumbing apparatus associated particularly with ice boxes, refrigerators or the like for private residences or apartment houses. An object being to provide a device to catch the drip from a refrigerator and direct the same into any suitable drainage pipe or system, and is particularly adapted for use in apartment houses and the like obviating the necessity of a removable drip pan.

WHEEL BEARING FOR FURNITURE.—R. J. EHLERS, Northport, L. I., N. Y. The object of the invention is to provide a wheel bearing more especially designed for use on bassinets, cribs, beds and other pieces of furniture intended to be wheeled about; the said wheel bearing is arranged to permit of quickly mounting the wheels on the piece of furniture without requiring skilled labor and to insure easy running without danger of wabbling or bending. The device is simple and durable in construction.

Hardware and Tools

VALVE-HANDLE.—W. S. NEIL, Minot, No. Dak. The frequency with which valve handles are broken and the fact that valves then cannot be controlled except with a "Stillson"



DETACHABLE VALVE HANDLE

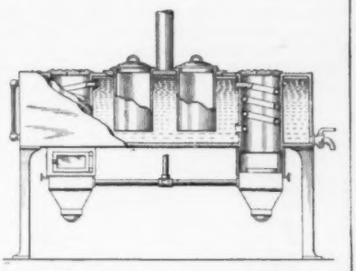
wrench, have led the inventor to provide a valve handle which will fit any size of valve stem and be affixed thereto as a permanent factor, or in case of emergency be quickly detached therefrom and applied to another valve stem of different size.

DRILL AND WIRE GAGE.—R. ICHIBA, 136 W. 109th St., c/o C. Gorch, New York, N. Y. An object of the invention is to provide a caliper gage which may be readily applied to twist drills, wire of all kinds, and rods, for calipering the size thereof and for permitting the mechanic to read the drill or wire size directly from the graduated scale of the caliper. A particular object is to provide a precision instrument with a set of lettered size graduations upon one side and a set of numbered graduations on the other.

ADJUSTABLE AND RELEASING GUARD FOR SLICING KNIVES.—C. H. KRAPF, 423 3rd St., Brooklyn, N. Y. The object of this invention is to provide an adjustable and releasing guard for a slicing knife arranged to permit the user to cut slices of bread, meat or the like of any devised thickness, and to readily release the slice at the option of the user. Another object is to enable the user to remove the cut slice and deposit it in another place without touching the slice.

Heating and Lighting

STOVE.—B. H. DICKSON and J. E. FREY, Yuma, Col. This stove is adapted to function as a cooking unit and also as an efficient hot-



A CROSS SECTION SHOWING ARRANGEMENT OF THE PARTS

water heater for cooking. The cooking of the food may be started on a dry burner and then be transferred to a receptacle which extends into the hot water reservoir.

HYDROCARBON BURNER.—A. KAUFMAN, 402 E. 53rd St., New York, N. Y. This invention has special reference to burners for kerosene or the like calculated for the development of an intense heat of a satisfactory and safe nature and with a minimum expenditure of fuel. The important object of the invention is to provide a simple and safe means for generating a maximum amount of heat from kerosene or similar oils relying especially upon the mixture of gasses delivered direct from the oils with a much larger amount of oxygen than is ordinarily experienced.

Machines and Mechanical Devices

SHEET GUIDE FOR PRINTING PRESSES.—C. F. HUNEYCUTT, Box 965, Charlotte, N. C. An object of the invention is to provide a movable sheet guide particularly adapted for use with bed-and-platen presses of the Gordon type in which the guides will engage with the sheets as they are fed to the platen, influence them to proper positions for impression and leave the impression surface of the platen immediately prior to the act of impression with the sheets maintained in proper position by the gage ordinarily provided.

FLEXIBLE COUPLING.—J. C. SHELER and R. B. AUSTIN, 310 Marble St., Cadillac, Mich. The invention refers more particularly to a shaft coupling provided with a plurality of flexible joints so that power may be transmitted from one shaft to another at different angles. Another object is to provide a coupling which will transmit power at an angle thereto so that the driven shaft will rotate noiselessly, smoothly and without vibration.

DUPLICATING MACHINE.—H. COHN, 1060 Madison Ave., Albany, N. Y. This machine is arranged to print at each revolution of the printing drum not only the body of the letter but the heading as well. The heading appears as printed by inked type and the body as printed in imitation of typewritten work.

SHOE SHINING MACHINE.—C. CALDES, 22 Rutgers Ave., Jersey City, N. J. By means of this invention a single attendant in a shoe-shining parlor may operate more than one machine, regulating the machines to stop when the proper amount of brushing or other work is done. The brushes are arranged to move back and forth on the diffeernt parts of the shoe either automatically or under manual control.

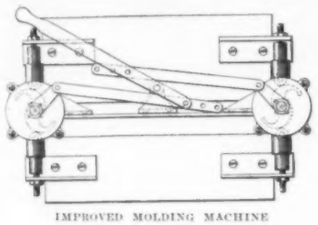
PEARL BUTTON MACHINE.—P. F. DUSHA and A. FEYK, address Holub-Dusha Co., 1797 1st Ave., New York, N. Y. This machine is particularly adapted for making buttons of the type known as shank buttons and is an improvement on patent No. 1,182,660. Special means are provided for preventing the drill from bending and from breaking or splitting the shanks while they are being drilled.

MACHINE FOR MAKING BUTTER.—J. A. SHEARE, The Esplanade, Henley Beach, State of South Australia, Australia. This machine for churning cream into butter comprises a receptacle arranged to revolve in a circular path while at the same time it receives an oscillatin motion. By this means the contents of the receptacle are subjected to a violent agitation and the cream is churned into butter in a very short time.

TAKE UP STOP MOTION.—H. R. BAUER and H. F. REINHOLD, 60 Clifton Ave., Clifton, N. J. An object of the invention is to provide a take-up stop motion for power looms, arranged to prevent the formation of a defective fabric by rendering the take-up inoperative and thereby preventing it from advancing the woven fabric in case the filling or weft

threads breaks or runs out in the shuttle. Another object is to enable the weaver to quickly make necessary repairs and to prevent the restarting of the loom unless the stop motion is first reset.

MOLDING MACHINE.—A. DIEHL, c/o Geo. B. Smith, 407 Bushnell Bldg., Springfield, Ohio. An improvement in molding machines is provided by this invention. A simple me-



IMPROVED MOLDING MACHINE

chanism is employed for simultaneously lifting the cope and the match plate from the drag. The lifting mechanism is operated by a single lever under the control of the operator and the parts are held parallel during the separation.

TEST VALVE.—G. ERNST, 44 Oakland Terrace, Newark, N. J. It is customay in high tension steam boilers to provide a number of test valves in order to determine the accuracy of the water level in the gage glass. As these valves are liable to get out of order, Mr. Ernst has provided a special form of test valve which is claimed to be absolutely dependable.

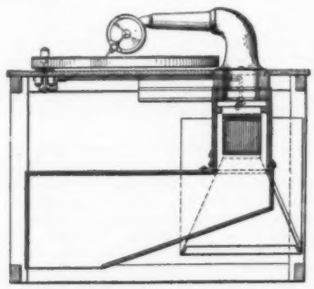
SLUB CATCHER.—F. WEBER, 148 Montana Ave., Union Course, L. I., N. Y. The invention comprises a device designed to prevent the passage of slubs, knots and the like which are formed on thread, cord, yarn, etc., and which prevent the proper passage of the cord through the eye of a needle or through weaving or knitting mechanisms of any sort.

FLEXIBLE COUPLING.—W. L. FRANCKE, New Brunswick, N. J. This invention is an improvement on previous patent No. 1,029,355, granted to Mr. Francke. The coupling is arranged to prevent undue bending of the shims on starting the driven shaft and to maintain the full power of transmission when started. The coupling is housed to prevent extraneous matter from impairing the action of the flexible members.

SEWING MACHINE GAGE.—S. MORGAN and S. HOFFMAN. Address Stanley Gerson, c/o Usona Shirt Co., 801 Broadway, New York, N. Y. In order to facilitate the sewing of buttons on garments, means are provided to do away with the preliminary measuring and marking of the garments. This results in a great saving of time and expense over the previous method of locating the position of the buttons.

Musical Devices

PHONOGRAPH.—H. GUILBERT, 317 W. Center St., Provo, Utah. The object of the invention is to provide a sound amplifying means which practically eliminates the metallic sounds of the needle on the record and reproduces the finest of tones and sounds. A



A VIEW IN TRANSVERSE SECTION

further object is to provide a phonograph having a sounding board and mounting for the tone arm which is located under and connected to the central portion of the sounding board and which also carries a horn or horns to amplify the sound.

REPEATING DEVICE FOR SOUND REPRODUCING MACHINES.—E. PEREMI, 329 Union St., Brooklyn, N. Y. In connection with phonographs employed for the purpose of teaching a foreign language, this invention provides a means for repeating a particular word, sentence or any small portion of the record whenever desired. The device may be attached to a phonograph without requiring any alteration in the construction of the machine.

Railways and Their Accessories

PERMUTATION LOCK.—J. P. GEBACHTY, 493 Grove St., Jersey City, N. J. This lock is designed particularly for use on railroad car doors, trunks and other devices, and is arranged to allow ready inspection of the car seal with a view of determining whether the lock has been tampered with while the car is in transit.

Pertaining to Recreation

AMUSEMENT DEVICE.—JACOB IRSCH, 351 Jackson Ave., Long Island City, N. Y. This amusement device is in the nature of a globe bicycle race with both the globe and the bicycle rider moving at a speed in proportion to the speed of movement of the operator. The object is to provide a number of racing figures on bicycles with manually actuated devices for driving them and an automatic disconnecting device for cutting off the driving devices when operated at too high a speed.

Pertaining to Vehicles

TIRE.—W. H. MCGOWEN, 16 No. 12th St., Vincennes, Ind. The invention has for its object to provide a tire having a resiliency approximating that of a pneumatic tire, without the faults, in that the tire is not subject to blowouts from punctures. The device comprises a filler for tires in the form of an annular hollow support gradually increasing in width from its outer face toward its inner face, a series of arched springs connected with the support and a shoe enclosing the support.

RESILIENT WHEEL.—H. C. ANDERSON, 2461 Fresby Ave., Westchester, N. Y. The invention has for its object the formation of a wheel which possesses all the resilient qualities of a wheel having a pneumatic tire. Another object is to provide what is the equivalent of a pneumatic hub for a wheel whereby the pneumatic cushioning means are so placed and guarded as to be practically indestructible in so far as traction or contact with the ground are concerned.

RESILIENT TIRE.—F. PERDALA, c/o John Soiko, 91 Titchenor Ave., Newark, N. J. The object of this invention is to reduce puncturing of the inner tube to a minimum. The tire is arranged to produce a desired cushionng effect and permt of readily removing a worn out tread from the shoe and replacing it by a new one without requiring removal of the shoe from the wheel rim.

AUTOMOBILE BUMPER.—F. KAMMITTER, 9 Henry St., New York, N. Y. The invention has reference more particularly to an automobile bumper of the flat spring type. An object is to provide a bumper which is secured to the bumper supports by a plurality of spring members so that in case of a breakage of one of the members during a collision the remaining members will still support the bumper and prevent damage to the automobile.

RESILIENT WHEEL.—A. JIMENEZ, 413 W. 156th St., New York, N. Y. The invention contemplates the provision of a wheel in which the movable parts are entirely exposed so that they may be readily cleaned, in which no more oil is required than the usual chassis springs and in which, no matter how caked with mud, or other matter, the parts will always operate positively. The resilient effect is produced by means of apparatus located between the ends of supporting members extending between the axle and the lower part of the rim, and the rim itself.

Designs

DESIGN FOR A FAN.—C. M. LEVETT, 507 W. 186th St., New York, N. Y.

DESIGN FOR A HEAD RING FOR ELECTRIC LIGHT FIXTURES.—H. SHLAMOWITS, 3914 12th Ave., Brooklyn, N. Y.

DESIGN FOR A RUBBER SHOE PLATE.—D. H. ELEY and T. H. RYAN, 323 Board of Trade Bldg., Norfolk, Va.

The Third Degree for the Baseball

(*Continued from page 219*)

standing considerable stretching, these qualifications adapting them for use as baseball covers. The horsehide covers are sewed on the balls when wet and as they dry they shrink and tighten on the balls so that when ready for service they are as tight as the bark on the tree. Fabric covers are not suitable as baseball overcoats because they lack in resiliency, stretching ability and durability.

During the war the Government wished to purchase many thousand baseballs for the use of the soldiers both at home and abroad. Six different factories offered samples and bid on these huge contracts. The War Department submitted the matter of selecting the best balls from the samples offered to the National Bureau of Standards which as a result inaugurated the first baseball efficiency tests ever attempted. It was impossible at the time to subject all the baseballs to performance tests on the actual field of play. Hence laboratory methods for the determination of the durability, wearability, adaptability and efficiency of the balls were devised.

All the balls were first subjected to rebound tests to determine their resiliency. Each ball was dropped on a wooden plate from a carefully measured height, the rebound in each instance being accurately measured and the average of five rebounds being accepted as the official test figure for each ball. Subsequently the balls were all run through a tumbler machine similar to that used in foundries to scale the dirt from castings, which subjected the covers of the balls to friction and abrasion test.

A hook 1/16 of an inch in diameter was then slipped under a stitch in each of the ball covers and the force necessary to rip the stitch out of place was ascertained. In all cases it was determined that, invariably, the stitches would break before the leather would tear. Then the double lacings used to sew the cover of the ball were removed and their tensile strength was determined on special machines for that purpose. The leather covers were cut into strips one inch in width and tested for tensile strength and elongation.

Subsequently the ball interiors were thoroughly dissected and the qualities, color and strength of the string and yarns were ascertained while the character of the windings was carefully studied. The best balls were found to have rubber cores surrounded by continuous windings of good quality yarn with a thin layer of cotton thread on the outside of the ball. Some of the inferior balls were wound with only about 50 per cent of good wool while the balance was cheaper material which was not as durable. Most of the balls contained from two to four different windings of woolen yarn. The percentage of wool used ranged from 50 to 83 while the percentage of cotton thread varied from 0 to 21. Some of the balls contained no sizing—a chemical substance like glue or potato starch which is added to the wool and cotton windings to make them sticky. The rubber cores were also subjected to rebound tests while their powers to resist pressure and their compactness were also determined.

When the balls were dropped a distance of five feet the range of rebound varied from 28 to 29.5 inches while where the drop was ten feet, the rebound ran from 48 to 52.5 inches. The composite weights of the balls varied from 140 to 144 grams indicating that the weight corresponded closely in all instances to the official standard. Measured in terms of the different component parts, the weights were distributed in this wise: lacing cord, 1 to 1.6 grams; first winding, 4.8 to 10.3 grams; second winding, 15.5 to 27.8 grams; third winding, 16.5 to 23 grams; fourth winding, 31 to 54 grams; leather cover, 23 to 30 grams; rubber

center, 22 to 29 grams; sizing, 0 to 7 grams.

The tensile strength tests showed that the baseballs, in the main, were designed for rough and ready service. The tensile strength of the lacing cord ranged from 27 to 46 pounds per strand as it was pulled from the ball. After the balls were dismembered, the tensile strength of the laces varied from 7.1 to 11.4 pounds per strand. The yarn of the first winding had a strength range of from 0.8 to 3 pounds per strand; that of the second, 0.8 to 4 pounds; the third, 1 to 2.8 pounds and the fourth, 0.95 to 4.4 pounds per strand. The tensile strength of the leather cover varied between 48 and 85.9 pounds per square inch while the stretch of the leather ran from 26.5 to 42 per cent. A 15-ounce load applied to the rubber centers through a disk of the same radius of curvature as the rubber cores resulted in a compressibility of from .003 to .008 of an inch. When dropped 58 inches the rubber cores rebounded distances of from 47 to 48 inches, indicating extreme liveliness and resiliency.

As a result of these tests, the sample balls submitted were divided into three classes. The balls which qualified in the first class were purchased by the War Department and shipped in enormous quantity overseas and to army camps in this country. The efficiency of these balls under actual playing conditions was high and the consensus of evidence indicates that the unique laboratory trials originated by Uncle Sam's experts to determine the comparative value of different makes of balls were extremely efficacious.

Handling High Voltage with Bare Hands

(*Continued from page 219*)

The safety staging is about 90 per cent wood and has no capacity, so that as soon as the man's body takes its charge, there is no further sensation.

The designer of this ingenious safety staging guarantees satisfactory results up to 110,000 volts and states that this limit will soon be extended. Insulators can be tested and changed and the entire pole top rebuilt, if desired. Switches may be cut in, arms changed, slack cut out, heavy lines tapped; in fact, any job which has ever been done on a 2,300-volt line can now be done on the higher voltages under full load.

A few of the advantages claimed for this new method are: The man is placed in a position where he can work easily and naturally with his hands, which would not be possible otherwise unless the current were turned off. The quality of the work done is equal to or better than that done on a "dead" line with a platform to stand on. The men are said to be far better safeguarded than would be the case in working on lower voltages from the pole, with rubber gloves.

Muggy Days and Air Thirst

(*Continued from page 220*)

water vapor per unit volume is 4.7 grams, while at the latter there are 9.3 grams present or nearly twice the amount.

To add to our bewilderment a locality may have a lower humidity than another and yet be damper. Who would imagine that on a winter morning Boston with a mean humidity of 73 per cent would yet be drier than Yuma with a humidity of 56 per cent at the corresponding hour? Yet it is so, and the Arizona city has three times the quantity of water vapor present at the Hub.

Always in considering relative humidity the temperature and the prevailing wind must be taken into account.

It would be a great boon to physicians if some reliable index of the air thirst in different localities could be given them; a table of *true* relative humidities, one in which the water vapor present was

compared with standard values for definite weather conditions.

Keeping the Human Engine Cool

And as for these muggy days, these days which are the exact opposites of Castilian days, we know that, to quote from an old Spanish proverb "No wise man will argue with his friend" on such a day. For we are all "touchy." We are fretful, not entirely because the day is warm; a succeeding day may be even warmer and the sense of uneasiness less.

The explanation lies in the degree of air thirst. On a muggy day, the thermometer may read 1,112 on the new Absolute Scale, i. e. 87 degrees Fahrenheit. The relative humidity or ratio of vapor pressures is high, say 90 per cent. It is a day when the best humored fat men become somewhat cynical. One perspires freely but the perspiration must be wiped away, for it does not evaporate.

Next day the temperature may be higher, perhaps 1,120, or 91 degrees Fahrenheit but if the relative humidity is 65, due possibly to a light northwest wind, then one is fairly comfortable notwithstanding the added heat. There is actually less water vapor, the amount being 20 grams as against 30 on the muggy day. As we perspire we reduce the skin temperature 22 grads, while on the muggy day we could not cool more than 6 grads. Small wonder that we fan vigorously on muggy days and "fuss" because the fanning is not more effective.

On a warm day or in a crowded, heated room, we feel "stuffy" because we one and all load space with water vapor, respiring as well as perspiring; and the thirst of space for water vapor is soon satisfied. Our bodies are heat engines, driven by internal combustion of food; and we readily become heated. If we had indicator gages we could watch the moisture and temperature rise; and just as soon as these passed certain critical values, our feelings of discomfort and irritability would become evident.

It is the effort to adjust ourselves to new requirement which makes us uneasy. We are fighting to keep a balance between heat developed within, heat thrust upon us, and heat expended. It is important to keep warm enough to be comfortable, but equally important to keep cool enough to be comfortable; and this last during the dog days is best accomplished by efficient skin action, and the vaporization of sweat. A dry dog day facilitates this; a damp dog day makes it difficult or even impossible.

Where Willow Ware Comes From

(Continued from page 222)

the spacing recommended by Uncle Sam for purple willow, plants are set 6 by 30, 9 by 30, or 12 by 30 inches.

The first two years is the critical period for the young plants. Where the cuttings are closely spaced, hand hoeing must be practiced as often as necessary to keep the weeds in check while where wide spacing is pursued a horse can be used to perform this work. Cultivation must be thorough but it should never be deeper than 2 to 3 inches. Where cultivation is properly practised and where the spacing of the plants is correct, it is almost impossible for the obnoxious weeds to gain a foothold. Frequent and regular inspection of the willow tract is essential in order that the owner may stamp out and control such pests as morning glory vines, caterpillars and dodder whenever they appear.

It is inadvisable to neglect spots where plants fail as all such places should be replanted the same year in which they develop. Where such spots are neglected for long periods it is very difficult ultimately to set out replants which will live and flourish. Usually the replants should be set out each season after the willows have been cut over at harvest time, in order to give them an early start. The replants should be allowed to grow for two seasons without cutting and then should be cut back to the original size of the second season plants as otherwise they will shade the older, established plants.

Generally, the willow should be cut before the buds begin to swell as late cutting after the growth has started in the spring restricts the output of the succeeding crop, while it also retards the new growth. Willow rods that are to be steam-peeled may be harvested as soon as the leaves fall and the wood has matured. Rods which are to be sap-peeled or used for cuttings should not be removed until December or January unless satisfactory storage facilities are available. Usually, the ordinary hook knife is the best tool for cutting willow rods as where pruners are used it takes from one-third to one-half more time to perform the work. Stools should be cut as low as possible as practical experience has demonstrated that the best longtime results obtain where this method is followed. Under labor conditions which existed previous to the war, the average cost of cutting willow rods ranged from $10 to $15 an acre where the yield did not exceed two to three tons green weight.

As soon as possible after cutting, the rods should be bundled according to size and shape, either binder twine or small willow rods being used. After the leaves appear in the spring, the rods have to be kept in water until peeled as otherwise they die and then it is impossible to remove the bark. For this reason the rods are kept in pits where the water is deep enough to cover the ends of all the rods, the willow crop being kept upright in such pits until time for peeling arrives. The difficulty of securing labor which will properly peel the rods by drawing them between two steel plates or bars which have spring enough to break but which do not crush the wood is often the limiting factor in basket willow culture. The industry would be vastly benefited by the invention of a practical peeling machine which would eliminate this costly hand labor expense.

Experts maintain that the fact that most of the American-grown willow is steam-peeled is disadvantageous to the trade in general as it lowers the market quality of the rods and also centralizes the industry in the hands of a few dealers instead of under the control of the small growers and basket makers. After being peeled the rods should be dried thoroughly for one to two days in the hot sun before being bundled. It is necessary to cover them at night and during rainy weather as, otherwise, the rods lose their whiteness. Usually, the preferable time for sorting the rods is during the peeling process.

Ordinarily the income from the basket willow farm does not amount to much until the third year but henceforward up to the fifteenth season the average annual net profit per acre should range from $85 to $100. Abroad, willow baskets are used exclusively, hampers of all grades and quality being made from willow. In America, pine, oak, ash, elm, reed and rattan baskets are on the market in competition with willow to such an extent that a dependable and profitable market exists for only the finest grade of fancy willow baskets. On this account the bulk of the American willow supply is used in the manufacture of furniture.

The Heavens in September, 1920

(Continued from page 224)

be easy to see. Mars is past quadrature, and is an evening star, setting about 9:30 p. m., standard time, in the middle of the month. Jupiter is a morning star, rising from one to two hours before the sun. Saturn is in conjunction with the sun on the 7th, and practically invisible. Uranus is in Aquarius, and is visible all the evening. Neptune is a morning star in Cancer, inconvenient to observe.

The moon is in her last quarter on the 5th at 2 p. m., new on the 12th at 8 a. m., in her first quarter on the 19th at midnight, and full on the 27th at 9 p. m. (eastern standard time). She is nearest the earth on the 8th and farthest away on the 20th. As she circles around the zodiac, she passes near Neptune on the 9th, Jupiter on the 11th, Saturn and Mercury on the 12th, Venus on the 13th, Mars on the 18th, and Uranus on the 25th—none of the observable conjunctions being close.

At 3:29 a. m. on the 23rd, the sun crosses the celestial equator and enters the "sign" of Libra; and, as the almanacs say, "Autumn commences."

Clark's Island, Plymouth, Mass.
August 20, 1920.

A Forward Step in American Airplane Engines

(Continued from page 226)

There are 12 cylinders of 5¾-inch bore and 6½-inch stroke, and 2 banks of 6 cylinders forming a Vee with an included angle of 60°. Two inlet and two exhaust valves are used for each cylinder, each valve port being 2 inches in diameter. Each pair of valves is operated by a duplex rocker arm, working in conjunction with a single cam. Two spark plugs are used per cylinder and thanks to the clean "alley" between the cylinders, are notably accessible, not requiring the use of a special wrench. The ignition current is supplied by an improved battery system which is arranged in duplicate. The distributor heads are fixed in place and the spark advance is obtained with a slidably controlled drive shaft.

The engine complete weighs 1,118 pounds and in its initial test delivered 578 hp. at 1,920 r.p.m. or 1.94 lb. per b.h.p., as against an average of 2 to 2¼ lb. per b.h.p. in the best of the war-time engines. This can be considered a very satisfactory performance in view of the fact that the engine went through its initial test in exactly the condition received from the assembly department and without any modifications. Gasoline consumption was at the rate of .52 lb. per b.h.p. hr. for maximum power carburetor setting and .45 lb. per b.h.p. hr. for maximum economy carburetor setting. Oil consumption was at the rate of .025 lbs. per b.h.p. hr. which also represents a remarkably good economy.

It is evident that an engine of this type has a wide range of usefulness due to its rugged design in combination with comparatively light weight. For use with a flying boat, heavily loaded commercial or war plane, a flying speed of say 80 m.p.h. corresponding to 1,275 to 1,350 r.p.m. of the engine with an output of 400 to 420 hp. could be maintained and this would undoubtedly allow of 250 flying hours without overhauling the engine. If run at somewhat higher speed, say 1,500 r.p.m., the engine is capable of developing about 475 hp. and would be eminently suitable for long distance work at comparatively high speed, say 100 to 120 m.p.h. such as would be required for a bombing plane in war time or a mail plane in peace time. If it was desired to utilize all the power the engine is capable of developing, a light low-resistance plane could be designed around this engine which would have some startling speed possibilities far in excess of anything yet accomplished.

It is to general commercial uses, however, rather than to employment in war or in racing, that I look for the greatest value of this engine. Since America is not and never will be a military nation, aviation cannot hope for adequate development through appropriations for naval or military purposes. Yet until we are in a position to dominate the air above our country in case of emergency, America will not be safe.

The only answer to this problem is the development of commercial aeronautics. I believe that America is now second to none in the matter of engine design, except possibly in air-cooled fixed radials, and though we are not so far advanced in plane design, we can lay claim to having originated most of the ideas used in airplanes today all over the world, and I am convinced that if we can make a business of aeronautics, thus putting it on a sound financial basis, we have the talent and the facilities to lead the world.

This Year's Nominations for the Hall of Fame

(Continued from page 226)

bronze tablet and put up in the corridor of the Hall. If Hunt is elected this year there will be two tablets each crediting a different person with the invention of the sewing machine.

It is claimed that Hunt invented a machine for sewing which was provided with an eye in the point of the needle and a shuttle in 1834-1835, which was more than ten years before Elias Howe obtained a patent for a sewing machine. Among other inventions of Walter Hunt is the paper collar, the safety-pin, a repeating rifle and pistol, a forest saw with lever for cutting and felling trees, an improved kerosene lamp, a fountain pen, an improved stopper for bottles, etc.

The inventors elected to the Hall of Fame in previous elections and whose names are already inscribed on bronze tablets in the Hall are Robert Fulton, inventor of the steamboat; Samuel Finley Breese Morse, inventor of the telegraph; Eli Whitney, inventor of the cotton gin; and Elias Howe, inventor of the sewing machine. Howe was elected in the last election, 1915. The others were all elected in the year 1900 at the first election when the Hall of Fame was built and inaugurated.

The ten scientists whose names appear on the 1920 ballot are Benjamin Thompson, Matthew Fontaine Maury, Benjamin Pierce, Nathaniel Bowditch, Spencer Fullerton Baird, Benjamin Silliman, Josiah Willard Gibbs, Samuel Pierpont Langley, Henry Lewis Morgan, and Simon Newcomb. The four latter are new nominations this year, while the former six have been voted upon in every election since and including 1900.

The scientists already elected and whose names are on tablets in the Hall are John James Audubon, Asa Gray, Louis Agassiz and Joseph Henry. The two latter were enrolled in 1915, while Audubon and Gray were elected in 1900.

There are two inventors whose names appear on the ballot this year but not under the classification of Inventors. One is William T. G. Morton, the dentist who invented anaesthesia and an apparatus for its administration. Dr. Morton is on the ballot under the classification of Physicians and Surgeons. He received a large vote in the elections of 1910 and 1915 and it is likely that he will this year be elected. Dr. Morton, of course, properly belongs under the classification of Inventors. The other inventor who, quite properly, appears in the class of Authors, is Thomas Paine, author of "Common Sense," "Rights of Man" and "Age of Reason." Thomas Paine invented the iron bridge, the planing machine, the hollow candle (which is the principle of the modern central draught burner), etc.

The new nominations on the final ballot now in the hands of the 102 electors to the Hall of Fame are the nominations that were selected by the various groups that considered the names submitted on the preliminary ballot about one month ago. Many names were discarded altogether on the preliminary ballot. Only those names which were approved by a majority of the electors in the various classes achieved a position on the final ballot.

The group which passed upon the names of inventors and scientists is com-

posed of Alexander Graham Bell, Henry Fairfield Osborn, John Burroughs, Dr. William H. Welch, George F. Swain, General George W. Goethals, Charles D. Walcott, Robert S. Woodward, Dr. Charles H. Mayo, Dr. William J. Mayo, and George Ellery Hale.

The 102 electors to the Hall of Fame are persons of distinction in various professions and are located in all sections of the country. These electors are listed in seven groups as follows: Actual or Former University or College Presidents, Historians and Professors of History, Scientists, Authors and Editors, Men and Women of Affairs, Actual or Former High Public Officials, Actual or Former Justices, National or State.

There are "vacancies" in the Hall of Fame to be filled this year by the names of twenty men and ten women—if elected. It is unlikely that more than a dozen men and five women will be given a vote large enough to secure their admission to the Hall.

Smothering Fire with Bubbles of Gas

(Continued from page 228)

dioxide will naturally have disappeared. There will remain, however, a curious mass distributed over the area which will consist largely of the sodium sulfate and the aluminum hydroxide shown at the right of the equation, or modifications of these.

It is not so long that the world has known exactly what is the thing we call *fire*. But, in 1786, the great Lavoisier revealed the truth in a single sentence: "Fire is the combination of a substance with oxygen." When the suds made as indicated is thrown onto blazing oil, it contains practically nothing that will combine with oxygen. The sodium sulfate, the aluminum hydroxide and the carbon dioxide, all, are chemical combinations already heavily loaded with oxygen. In so far as the oxygen of the air is concerned, the blanket of bubbles cares nothing for it. In so far as the oil is concerned, the bubbles hold on to their oxygen. The result is that the blanket does not feed the flame in any way. It acts principally as a shield, protecting the oil from the atmospheric oxygen.

The manner in which oil tanks are protected is, in general, as follows. The two solutions are separately kept in suitable containers at some suitable central station. Metal tubes are laid along the ground, or buried in it, from the containers to mixing chambers attached to the several oil tanks. These open on the surface of the oil at their upper ends. The solutions are, upon occasion, pumped through a double line of piping extending from the pumping plant to the tank, each solution along its own line. At the mixing chamber, the two mingle. The quick formation of the carbon dioxide at this point is competent to eject the suds as it forms. Where a considerable number of tanks are connected up with one station, the piping may be arranged so as to avoid the installation of a distinct complete double line of pipes for each and every tank. By the use of valves, certain branches may be cut off and others brought in; so that a complete double line will exist for the particular tank on fire.

The volumes of the two solutions required are equal. It is necessary then that the arrangements be such that equal deliveries are made at the mixing chamber. The twin duplex pump or the flywheel pump are approved types for the purpose. It is understood that the ordinary duplex pump is liable to be ineffective because of short-stroking.

The amount of foam or suds required for an oil fire will naturally vary with the character of the conflagration. Usually, a quart of each of the two solutions per square foot of surface will when mixed and converted into suds be competent to

put out almost any fire. Often, half this amount will be sufficient. A good sized oil tank having a diameter of 100 feet can be covered with suds in from 5 to 10 minutes, if a proper size of twin duplex pump is employed and the arrangements are otherwise what they should be. Each of the two solutions should be available in amounts of 600 barrels. The pipe lines to the tank should be of the 3-inch size and two mixing chambers should be provided on the tank. Arrangements may be made for discharging the foam from a nozzle.

Naturally, a substance usable for the quick extinction of oil fires may be employed to put out fires in general.

The development of the mechanical apparatus for the quick generation and utilization of fire-suds is an important side of things. Here American genius has played its part, as well as in connection with the perfecting of the process. Mr. O. R. Erwin has been and is one of the leaders in inventive matters. Many of his experiments have been conducted on a considerable scale. Thus, a considerable trench would be flooded with oil and the whole made the means of testing some phase of the practical development of the suds idea. Then there are others whose names have not been brought to the fore, but whose participation in the forward movement has been valuable. The whole development from the first germinal thoughts would seem to fall within a space of about a score of years.

Latest Patent Decisions

(Continued from page 229)

include a successful structure. Claims should cover what the patentee has invented, and nothing more. The plaintiff has failed to establish infringement.—*Whitlock Coil Pipe Co. v. Mayo Radiator Co. U. S. D. C. of Conn.*

Different Means to One End:—Suit in equity by Harry B. Ross against Overlin & Jameson. Complainant sues to enjoin infringement of its patent for improvement in motor trucks. Complainant's motor truck is adapted for picking up lumber disposed in piles, and transporting it in and about saw-mill and lumber yards, and depositing it at places of destination. The process is to drive over or straddle a lumber pile, pick it up, or raise it, by means of the motor used for propelling the motor truck, and, thus suspended beneath the frame of the truck, carry the same and deposit it where needed. Defendant Overlin has devised a motor truck of similar construction, designed to perform the same service and has secured a patent, also, on his machine. Complainant alleges infringement. Held, no infringement for, while Overlin's machine lifts, carries and deposits piles of lumber, it does not do so by the same mechanism as the complainant's truck, the lack being a principal horizontal beam, or a compound structure acting as a beam, receiving vertical load, and bearing vertically upon its supports.—*Ross v. East Side Mill & Lumber Co. U. S. D. C. of Oregon.*

Jurisdiction over Contracts:—The bill in this issue alleges that the plaintiff was the inventor of a useful invention in steam traps, and that by an instrument in writing he granted unto the defendant company the sole and exclusive right to manufacture and sell the apparatus—that he was to receive $100 within six months and $5 upon each apparatus sold by said company until he had received the sum of $1,800 in royalties. The bill further alleges that the defendants have sold a large number of steam traps covered by the patent, and on which royalties have accrued and have not been paid.

The motion to dismiss the bill must be granted. While there is a diversity of citizenship, the amount involves less than $3,000. The action is one for breach of contract and in no way involves a determination of whether the patent has been infringed. The bill is dismissed, holding as a matter of law, that a suit for accounting for royalties under a contract granting an exclusive license to manufacture a patented device is not one arising under the patent laws, and where the sum involved is less than $3,000, a federal court is without jurisdiction.—*Odell v. F. C. Farnsworth Co. U. S. D. C. of N. Y.*

Is the Dam Safe?

ENGINEERING literature is replete with examples of failures of structures traceable to inadequate knowledge on the part of the designer relating to the pressure exerted by the earth against these engineering feats. All of which magnifies the tremendous possibilites of this soil-pressure measuring device, and a series of experiments being conducted simultaneously by the U. S. Bureau of Public Roads and the Miami Conservancy District. The study of slumping in these five earth dams assumes this attitude of a wide core in hydraulic dams: Caving of the banks inward; extension of the soft core by the production of movable material in the banks; and, finally a bursting out of the core either causing or caused by a slip of the weakened bank.

Consequently, in the construction of this quintette of flood-protecting dams the central cores are to be nowhere wider than the final dam height. Such an observance necessitates that the hydrauling be conducted with a narrow pool, affording an ample section of stable, coarse material on either side. This proves practical if the finest portions in the materials are reduced to a suitably low percentage or if the surface drain from the pool is handled in a fashion to insure the disposition of excess fines. The resulting cone, with side slopes of approximately 1:2, is thought sufficiently wide for compactness and not favorable to induce caving of the bank along the contact. The base width of the core is only slightly in excess of 100 feet in any of the five dams, which is usually less than one-fifth of the dam base. The enlarged width of the outside bank is a source of additional strength.

Percentages of gravel, sand and clay present in the usable material have been determined by investigations, disclosing to engineers the available borrowpits most nearly approaching the requirements for desirable proportions of coarse and fine materials for dam construction. Frequent analyses of core materials are made.

As a precaution of avoiding an excess percentage of fine materials in the core, th mechanical analysis of the pumped material has been so clearly defined as to limit both the percentage of core materials in the total, and the percentage of silt and clay in this fraction. The core percentage is fixed by the cross-section of the dam. Limitation of fines in the core material is determined largely by the results of pressure measurements, as revealed by the soil pressure measuring instruments. The pressure measurements thus far indicate that the material in the cores of these dams is assuming a solid condition.

Resistance to penetration or the supporting power of the cores of the five dams is being determined by lowering a 6-inch cast-iron ball into the pool by a rope, its penetration under weight being recorded. The soil-pressure measuring instrument will doubtless reflect dependable information as to the lateral pressure existing in hydraulic dam cores, and determine the relation of vertical to horizontal pressures. Unpretentious in size and appearance, the device has immense possibilities, and it is not a remote objective for mechanical ingenuity to even outwit what is sometimes considered the fates of floods and misfortune.

Notes and Queries.

Kindly keep your queries on separate sheets of paper when corresponding about such matters as patents, subscriptions, books, etc. This will greatly facilitate answering your questions, as in many cases they have to be referred to experts. The full name and address should be given on every sheet. No attention will be paid to unsigned queries. Full hints to Correspondents are printed from time to time and will be mailed on request. Please write your queries; do not telephone them, please.

(14342) C. M. asks: I am writing to ask you for information in regard to insulating magnetism. Is it true that magnetism will penetrate any substance? Can you refer me to a treatise upon the subject? A. Magnetism penetrates nearly all substances with the same ease as it passes through the air. Iron, steel and a few other metals it penetrates with more ease than it penetrates air. It is evident from this statement that magnetism cannot be kept out of substances by ordinary insulation as electricity can be. The only way of insulating a substance from magnetism is to provide an easier path for the magnetism. This is done by surrounding this substance by iron since as we said above magnetism penetrates iron more easily than it does most substances. An iron box will screen its contents from magnetism. The iron should be at least a half inch thick for the best protection. You will find statements on this topic in text books. We do not know any treatise on the subject. It is called permeability.

(14343) H. A. B. asks: I have put up in my yard a sun dial. I got the directions from a copy of the Women's Home Companion, published in Springfield. That article said to find the latitude my place was in, and follow a table they gave, which I did. This place is West Liberty, Ohio, is in latitude 40°. They said to make the "gnomen" that casts the shadow 6 11/16 in. high and see to it that the noon mark, 12 o'clock, is pointed exactly north. Now what I want to ask you is this: If the pointer casts a shadow directly north and south isn't it noon at that place? A. Your question, which seems very simple, is far from actually being a simple question. If a sundial is set correctly so that the gnomon stands exactly north and south the sun at midday will be exactly in the plane of the gnomon and the shadow will fall on 12 of the dial. It is the middle of the time between sunrise and sunset—midday—but not twelve o'clock local time, the true time of your place, except on four days in the year, about April 15, June 14, September 1, and December 24. The dates vary a day or so because of our calendar, in which an extra day is inserted in February in leap years. The difference between the sundial and the local time is called the Equation of Time, of which you should have a table furnished with the dial. Correct the sundial reading for the equation of time and you will have your local time. But your place probably uses central standard time, which is six hours behind Greenwich time, the time of the 90th meridian. To set your clock by the sundial you will require your longitude west of Greenwich. This changed to time gives you your relation to central standard time. Subtract your longitude in time from 6 hours and you have the difference between your local time and central standard time. With these numbers you can set your clock by the sundial reading. Proceed as follows: To the sundial reading add or subtract the equation of time for the day. This gives you your local mean time. To this add the difference between your longitude in time and 6 hours. The result is central standard time, the time to which you will set your clock.

(14344) H. J. S. asks: Scientists and geologists have long stated that as the crusts of the earth cooled earthquakes would become less frequent and in time disappear. The exact reverse of this is now however the case with 468 recorded in 1919. Some of these have been very destructive to life and property and have been scattered throughout the world and are still continuing. Had they occurred during the war it would have been logical to suppose that the huge mine explosions had effected the stability of the strata. Christ said that famines and pestilences and earthquakes in divers places would be signs of His second coming. I do not understand geology so request that you give me a scientific or geological reason for these disturbances

and if the formation of North America is such that there would be no danger of quakes away from the western coast. A. The great earthquakes are mostly from one of two causes—the shrinking of the earth due largely to cooling, or the effects of volcanic action. Both of these effects must persist so long as the causes are active. In the long future both causes will cease to be active, and earthquakes must cease. But no scientist would say in years when that time will come. Certainly not in our time. Geology reckons time in thousands and in millions of years, and earthquakes now occur by the thousands each year. It is estimated that there are 30,000 earthquakes a year which are large enough to be perceived by the senses, and an almost innumerable number of lesser tremors which are too small to be perceived. Among these smaller earth tremors would be placed the mine explosions to which you refer. Such an explosion however does not jar the earth for any considerable distance. The great explosion of many tons of high explosives in Hell Gate, New York Harbor, many years ago, was recorded on seismographs for only about 200 miles, a very short distance compared with the distance to which a real earthquake shock is transmitted. Most of our earthquakes are due to the cooling of the earth and the shrinkage of its strata from cooling. The result is the breaking, folding, and slipping of the strata upon each other. A slip of but a short distance will produce a large effect upon buildings and the earth's surface. A motion of a fifth of an inch, it is said, will throw chimneys down. The greater part of the United States seems to be free from violent earthquakes, but in the past there have been great earthquakes in several regions. In 1811-1812 a series was felt in the lower Mississippi Valley, which has been characterized as "of world-shaking order." The last considerable earthquake in the East was the Charleston earthquake in 1886. These facts seem to indicate that severe shocks are not as common as a century and more ago. The great earthquake regions of the earth lie in two circles, one surrounding the Pacific Ocean and the other lying nearly east and west around the earth through the Mediterranean, southern Asia, the East and the West Indies. If you would have a good discussion of this subject we would advise you to get Tarr's College Physiography in which you will find about 100 pages devoted to it.

NEW BOOKS, ETC.

THE MODEL T FORD CAR. By Victor W. Page, M.S.A.E. New York: The Norman W. Henley Publishing Co., 1920. 8vo.; 410 pp. 153 illustrations.

The thoroughness and lucidity of this writer's instruction books are readily acknowledged by the army of students and readers which profits by them. This enlarged and revised edition of his work on the Ford car deals also with truck and tractor conversion sets, the Fordson farm tractor, and the F. A. lighting and starting system. Its multitudinous diagrams and photographs of actual parts are all in correct proportion, and materially assist the student in grasping details of construction, operation and repair. It is practical experience reduced to black and white—just such concrete facts as owners and drivers, dealers and repairmen should know.

UTILISATION DES ALGUES MARINES. By Camille Sauvageau. Paris: Librarie Octave Doin, 1920. 12mo.; 394 pp.; 26 illustrations.

Seaweed furnishes many valuable products. Potash, iodine, and adhesives are obtained from it; it is in use as a fertilizer, as food for animals, and even as food for man. M. Sauvageau, at the invitation of the *Direction des Inventions*, has given us an instructive work on French and foreign marine algae and the methods by which they are made to serve useful purposes, including American processes. He enumerates medical uses and gives the species used as bait by fishermen, while the identification of varieties is aided by numerous drawings.

A LAWYER'S LIFE ON TWO CONTINENTS. By Wallis Nash. 12mo.; 211 pp.; illustrated. Richard G. Badger, The Gorham Press, Boston.

Each phase of the experience, here so entertainingly set forth, covers some forty years of an extremely active life. The author relinquished a lucrative practice to assume the vice-presidency of a pioneer western railroad, the Oregon Pacific. Wallis Nash, throughout his long and busy life, has been a keen and discriminating observer of men and things; he writes with a facile pen and every page of these reminiscences is full of interest. Particularly so are the pen sketches of notable men with whom he was in close professional and social touch during his life in London. Thus, it was his good fortune for many years to be a neighbor and intimate friend of Charles Darwin. Speaking of Darwin's almost uncanny memory, he records how he went to Darwin's study and consulted him about a certain bug that was working havoc among his grapevines. "Go upstairs," said Darwin to his son Frank "and on the third shelf from the top of the left-hand book case you will find the journal for 18— of such a German Etymological Society. About page 257, on the right of the book and midway down, I think you will find the description of the insect and its life's history." And there or thereabouts we found it. It fell to Wallis Nash to handle the Bell patents in Great Britain, and he describes Bell as being in the 70's, a "tall, black-haired, handsome and very attractive man of thirty." At a meeting of the Society of Arts, he writes "the young lecturer made a very excellent impression; his effective and pleasantly modulated voice reached every person present." He speaks of playing Beethoven to Herbert Spencer "who sat by the piano and talked of the connection between brain and hand and eye in the interpretation of music." Another friend was Sir John Lubbock, and another the great Bessemer, who would talk freely of his early struggles, when funds were so low that even his wife's wedding ring was sacrificed—this on the eve of his final success.

AUTOMOBILE STARTING, LIGHTING AND IGNITION. By Victor W. Pagé, M.E. New York: The Norman W. Henley Publishing Company, 1920. 8vo.; 815 pp.; 492 engravings.

This is an enlarged, revised edition of a deservedly popular work by an author whose name is a synonym for the very best in automobile instruction. The repairman has to handle a wide variety of ignition systems; each variety, with its failures and their remedies, is made plain to him here. Elementary electric starter principles, and typical starting and lighting systems, their faults and the speedy location of them, are dealt with in the thorough fashion for which the writer is famous; there is a chapter on the design of electrical measuring instruments and their use in testing; the whole is prefaced by a chapter on elementary electricity, and every detail is opened to the eye by means of clean-cut figures, plates and diagrams.

AN INTRODUCTION TO THE STUDY OF CYTOLOGY. By L. Doncaster, Sc.D., F.R.S. New York: G. P. Putnam's Sons, 1920. 8vo.; 280 pp.; 31 figures, 24 plates.

The writer believes that cytological investigation is one of the most promising leads toward biological advance; his work, of wider scope than the text book, not only gives the important facts of animal cytology, but indicates how research in this branch is bound up with great fundamental problems. Careful selection is necessary to so condensed a treatment, and on the whole this has been successfully accomplished. The book describes the cell and cell phenomena, discusses accepted theories, and touches upon the mechanism of hereditary transmission and the rôle of the cytoplasm.

LUCK ON THE WING. By Elmer Haslett, Major, Air Service, U.S.A. New York: E. P. Dutton and Company, 1920. 8vo.; 303 pp.; 8 plates.

The humorous and the dramatic alternate through these stories of a sky spy. As Gen. William Mitchell points out in his laudatory introduction, the book has a double value: it is a truthful, gripping picture of the life of our air fighters during the great actions of Chateau-Thierry, St. Mihiel, and the Argonne: and it plainly shows how the lack of understanding of the functions of the Air Service resulted in the dissatisfaction that prevailed. Hilarious incidents mark the writer's capture and incarceration, and the stories are as well worth reading for their humor as for their information.

EXPERIMENTAL ORGANIC CHEMISTRY. By Augustus P. West, Ph.D. Yonkers-on-Hudson, New York: World Book Company, 1920. 8vo.; 469 pp.; illustrated.

In this college textbook a well-known instructor embodies the method he has long successfully used in mimeographed form. One of its claims to attention is that it combines textbook and laboratory manual in one, with printed directions that permit the student to do his own work, thus at once saving the instructor's time and developing self-reliance in the pupil. Dangerous and difficult experiments are excluded, exactitude in the preparation of compounds is insisted upon, searching review questions follow each chapter, and there are numerous charts, diagrams, and structural formulæ.

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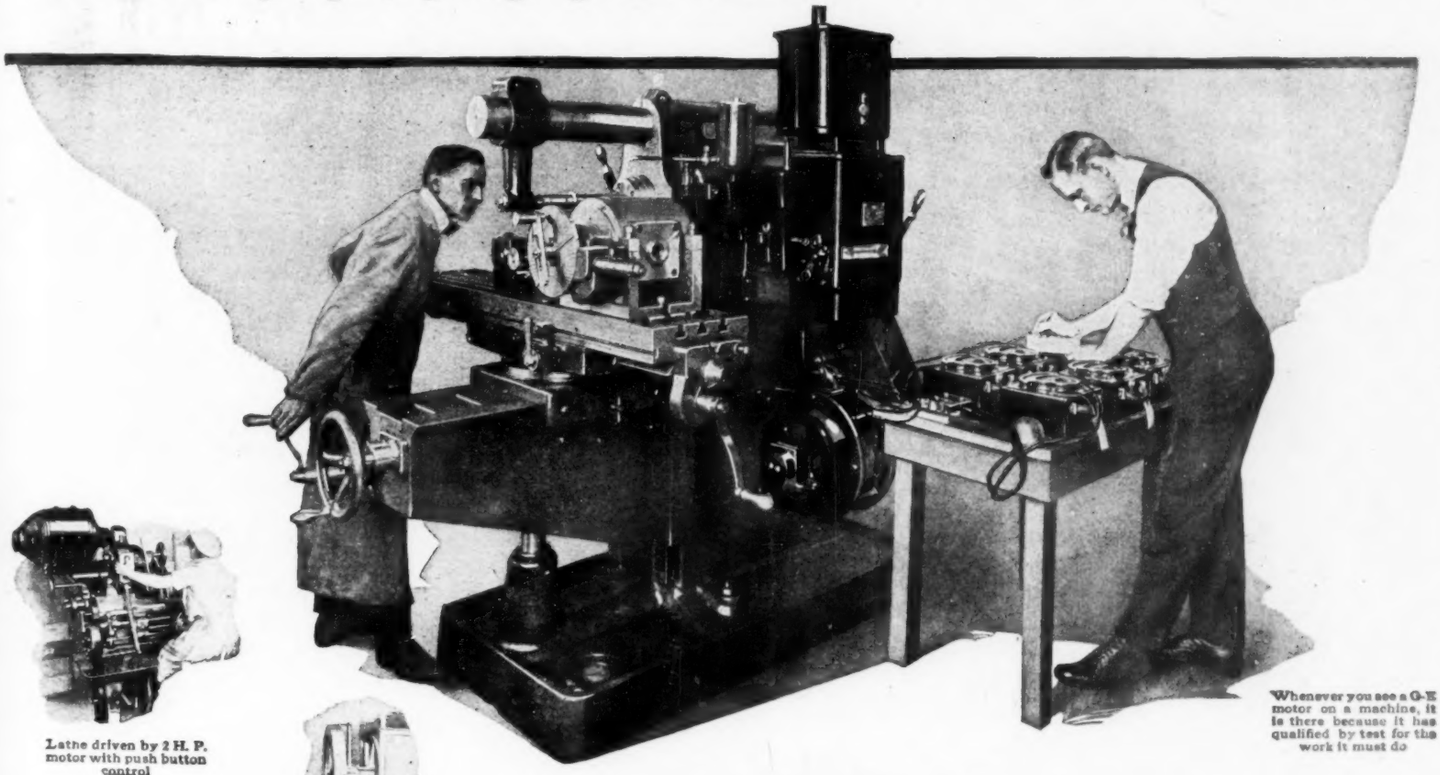

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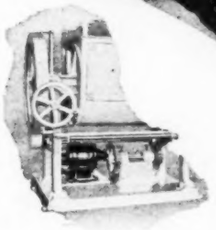
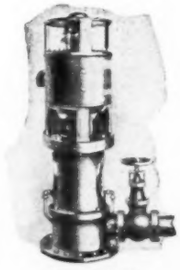
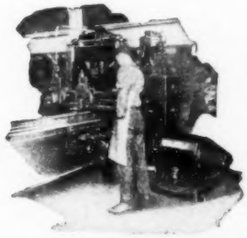


Dough Mixer driven by small motor geared direct



5 H.P. Vertical Motor driving water pump



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